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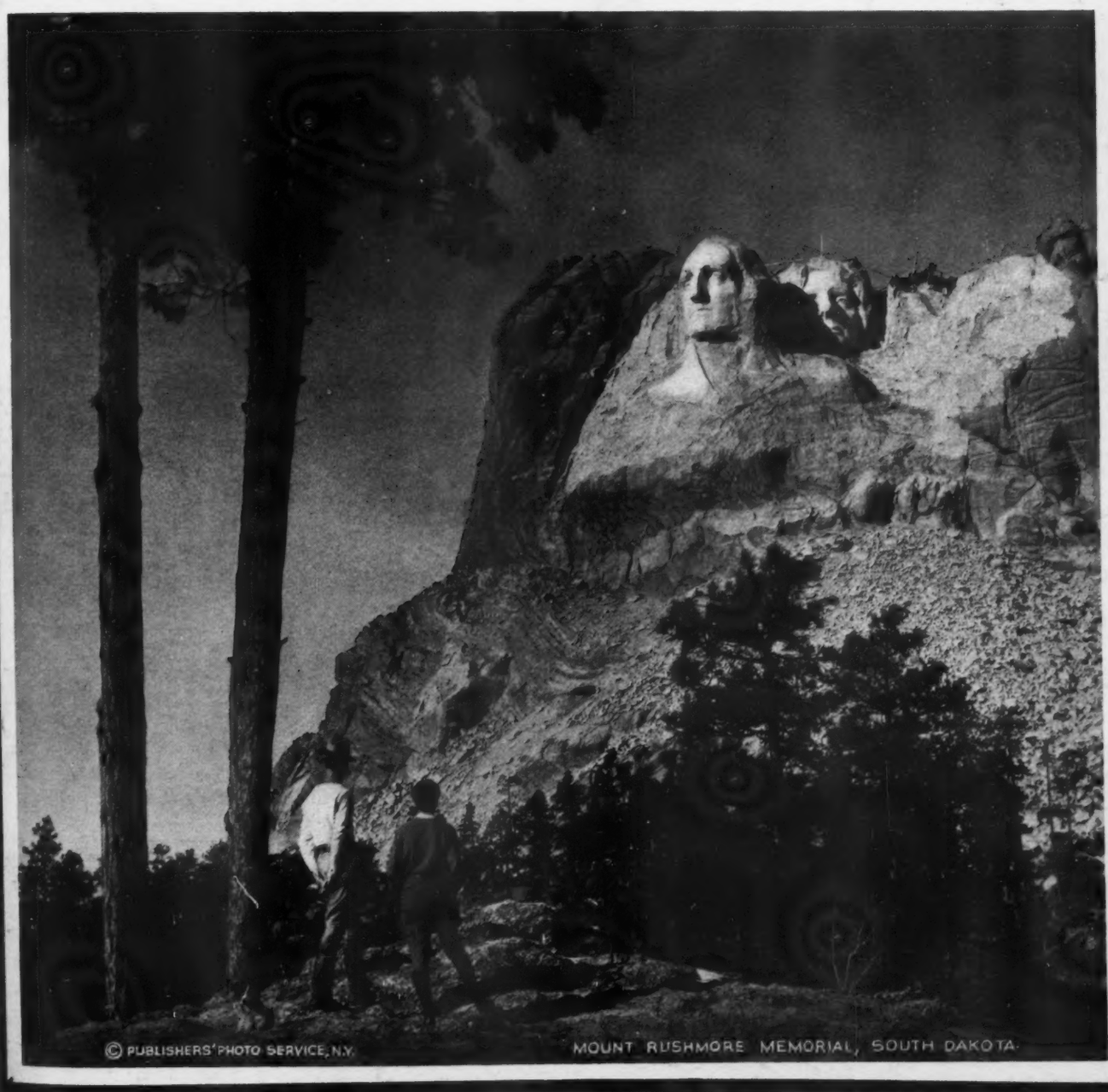

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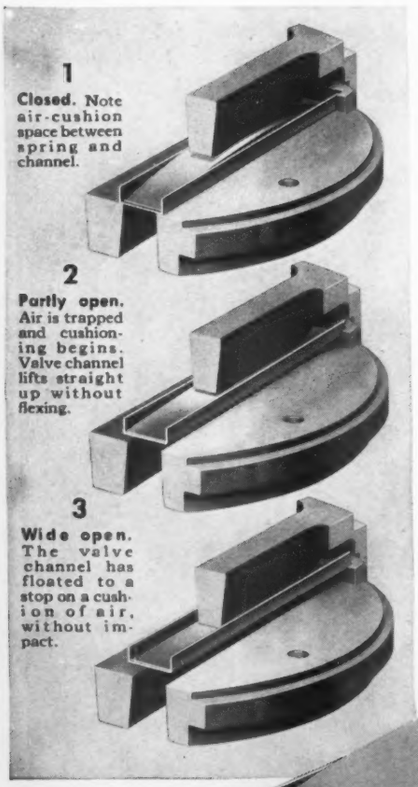
It has far greater effective lift area for the same diameter valve opening than any other plate valve that Ingersoll-Rand has ever used. This materially reduces air speed through the valve and directly increases efficiency of compression.

Each valve channel lifts uniformly throughout its full length, completely opening the port. Controlled cushioning, effective only at the end of the valve lift, gives maximum lift area, and insures perfect timing. Valve channels and the seat are accurately ground.



Sectional views showing full straight lift of valve channels and how trapped air eliminates impact.

SUSTAINED EFFICIENCY

Valve Channels are always guided back to the same position on the seat. The valve assembly is held in place by a crab which bears on the outer rim, thus guarding against warping or distortion of the valve seat by the cover set screw.

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Each valve channel floats silently t stop, attaining full opening without pact as shown in illustrations 1, 2 an

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FEBRUARY, 1936

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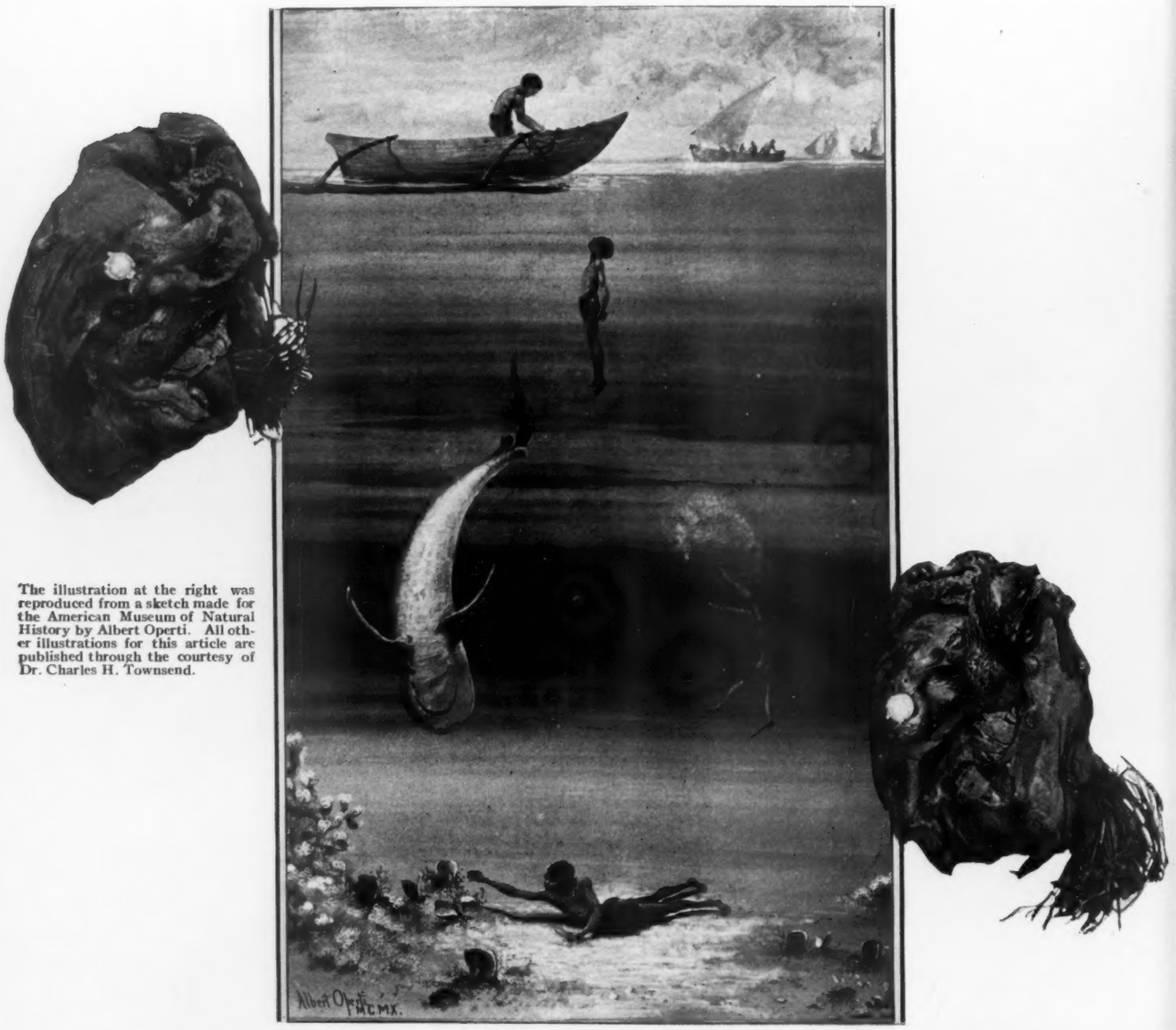
Modernizing the Pearling Industry

Robert G. Skerrett



The illustration at the right was reproduced from a sketch made for the American Museum of Natural History by Albert Operti. All other illustrations for this article are published through the courtesy of Dr. Charles H. Townsend.

"TORPEDO air flasks: where can I get them? I want to buy the kind fitted in the big 'steel babies' now carried by submarines and destroyers. You know, the sort that can be charged with air at a pressure around 3,000 pounds."

Some five or six years ago, these questions were asked in a booming voice by a man that was manifestly a seafarer; and all hands in the office at once sat up and took notice. Automobile torpedoes have no peacetime purpose except to train fighting seamen in their use; and air flasks—essential parts of those instruments of destruction—did not seem, offhand, to lend themselves to any other application. Pent up in those cylinders of special steel is the energy that drives the whirling propellers that send modern automobile torpedoes at high speed on their grim journeys.

SKIN DIVERS

Native pearl fishermen, armed only with a knife, descend feet first for about 10 feet, then turn and swim to the bottom. Some of them can go down more than 100 feet and can remain submerged as long as three minutes. At either side are pearl-bearing oysters taken from the waters off La Paz, Lower California. These oysters are much larger than the edible variety of commerce.

Lower New York is pretty familiar with the ways of the filibuster, and no one in that office had any wish to be hooked up with gun-running and kindred unlawful activities. But the chief was interested, nevertheless, and said: "No, we haven't anything like that for sale, but possibly we might be able to help you if you let us know what you want to do with the flasks."

Smiling broadly, the visitor answered the query and, without hesitation, began to tell the following story: "I want to use them in fishing for pearls. That is my business, and I have been at it for 20-odd years. I have followed that calling in the South Seas ever since I first found a sizable pearl. I've sailed from north to south and from east to west among most of the islands of far-spread Oceania in the everlasting hope that I might happen upon pearls like those that have made history. In most of the waters commonly fished, it is exceptional when a pearl of outstanding value is recovered, because continual fishing has

PEARLING CRAFT

Boats of various kinds photographed on the beach at Hikueru Island during the fishing season. The canoes in the foreground were made by native craftsmen. This island is the most important center of pearl-shell fishing in French Oceania.

greatly reduced the oyster beds, and the surviving oysters have had too little time to build up pearls that would bring really high prices. This is the prevailing situation, even though the entire pearl harvest during a year may have a value totaling hundreds of thousands of dollars. My name, by the way, is Victor Berge.

"For most of us," the interesting visitor continued, "the backlog of the business is the taking of mother-of-pearl shells, which are a steady article of commerce. The gold-lip pearl shell is one of the most sought after, and so, too, is the black-edge mother-of-pearl shell. According to their variety and their grades, pearl shells will fetch in American and European markets anywhere from $100 to as much as $800 a ton. The oysters are not like the familiar edible variety, as it is known in the United States. The pearl oyster is a big bivalve; and a full-grown one may weigh as much as 10 pounds, so the successful fisherman does not have to harvest a great many of them to make a tidy sum. The diver often does not sign on for wages, but works instead for a share of the catch; and many of the native divers of the South Seas are better off than the chiefs of their tribes or villages.

"All the while we are fishing for mother-of-pearl shells we are gambling against odds that some of the oysters will hold pearls, and possibly pearls of extraordinary size and beauty. For that reason, every oyster dropped on deck is soon opened and thoroughly searched when stripping the meat from the valves or shells. At the very beginning of my life in the South Seas, a pearl popped out of an oyster I was opening on the deck of a little Chinese trading craft, and I caught the glistening sphere before it could roll out through a scupper and back into the ocean. From that moment I was fired with the desire to engage in pearl fishing. Year in and year out since then I have harvested oysters and found some pearls, and the lure still grips me. I no longer sell my 'babies' to wandering buyers. Instead, I carry them to Paris where I can get better prices and have some of the pleasures of that lively city. I am still looking for pearls as big as pigeon's eggs: they have been found in the past and probably can be found again if we can discover virgin beds of oysters. It takes years for an oyster to coat with succeeding films of nacre the tiny parasite, or the irritating granule of sand, that provokes the process of a pearl's formation.

"I've done a deal of pearl fishing around the Solomon Islands. They are not safe for a white man even yet; but one must touch at them from time to time to refill fresh-water tanks and to replenish certain food-

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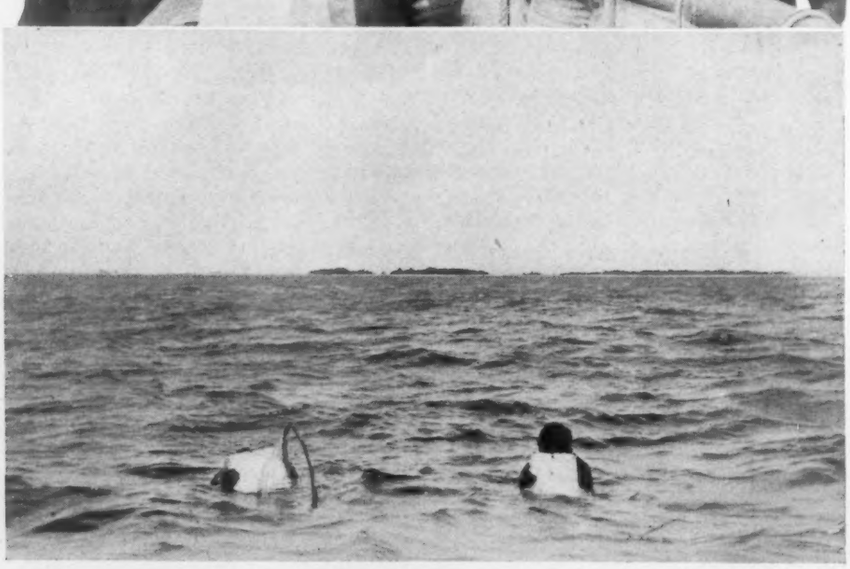
PEARLS as big as pigeons' eggs were found, among other rich adornments, in the tomb of an Indian chief that was opened latterly at Monte Alban, Mexico. Those pearls may have been buried there for half a thousand years, and surely came from the depths of the sea—possibly from the waters off La Paz near the tip of Lower California. The point of present interest is that oysters made those pearls in the centuries gone, and oysters of the same kind are, under favoring conditions, still forming pearls of like size and equal beauty. Novel mechanical aids are now helping in the search for them.

AT HIKUERU ISLAND

At the left is a group of pearl fishermen of the Tuamotu Archipelago in the South Seas resting between dives. Some of the huts in which they live are shown above.



SEARCHING FOR OYSTERS

Shown just above are two natives of French Oceania peering into the sea with the aid of the water glass, a boxlike structure having a glass fitted into one end.

stuffs. Great Britain has exerted a restraining influence upon some of the coastal natives, but no one knows just when the savage head-hunters of the jungle may appear on a beach. We commonly get the 'salt-water boys' to bring us our supplies, and we also recruit many of our divers from the same lads. They are familiar with the neighboring waters and also are likely to know where pearl-oyster beds are located. Those Polynesians are nearly as much at home in the sea as they are on land, and many of them can dive to a depth close to 100 feet, while a few can go to 120 feet.

"The nude or 'skin diver' may in exceptional cases stand a submergence of three minutes, but the majority of them do not remain underwater for more than a minute at a time. Whatever the interval, it includes getting down to the sea bed, groping about for oysters, and then returning to the surface to replenish the air in their sorely taxed lungs. It is hard and exhausting work, and not infrequently the divers become paralyzed or die of the bends. It is because of these physical limitations that the diving dress has been introduced in parts of the South Seas. It has made it possible for the native divers to descend deeper and to stay much longer on the bottom—covering wider areas and recovering larger quantities of oysters during each submergence. There are different sorts of diving dress used by the industry.

"My men," Captain Berge went on, "use diving gear that is totally unlike that commonly worn by American and European divers. The dress consists of a bronze hel-

TYPICAL DIVERS

Both sexes, including adults and large children, engage in pearl diving. As they share in their harvest, there is always the chance that they may become wealthy from a single fortunate dive. In the foreground is a native-built outrigger canoe.

met, fitted with a glass face plate, and of a waterproof jacket to which the helmet is secured by an air-tight joint. The jacket is belted in at the waist, and is further held down by a strap that passes from front to back between the legs. A valve at the front of the suit enables the diver to control the air supply reaching him through the air hose, and this supply is adjusted in accordance with the working depth. Weights are hung on the front and back of the jacket to counterbalance the buoyancy of the helmet. The jacket has short sleeves that are open at the bottom. To descend, a diver raises his arms so that air can escape from the sleeves; and to rise, he holds his hands down against his body so that air will accumulate in his jacket and provide the buoyancy needful to carry him quickly surfaceward. Because the rig is simple, a native South Sea islander can soon be taught to handle himself underwater in such a suit. He must be careful to keep his body upright and his head uppermost. Otherwise, the air might escape from his helmet and the enveloping water kill him by trying to squeeze him bodily into the metal headdress.

"Generally, each diver is provided with 150 feet of air hose, assembled in three sections of uniform length. This allows for some slack on deck, and also gives the diver leeway in moving about on the sea bed at a depth, say, of 100 feet. Currents will sweep the air hose in a curve between him and his surface craft, and he must drag his hose along with him if he move against the current. On the front of his suit is hung a fiber bag in which he puts the oysters that he detaches from the sea bed or a coral reef. While we keep pretty close watch on the length of hose issued to each diver, the natives will, at times, play a very risky trick when it seems to their advantage to do so.

"Because a diver has a share in his haul, he is tempted, when he thinks he sees a promising cluster at a depth beyond the reach of his hose, to get his attendant to sneak in an extra 50 feet to extend the air line. The increased depth and the added physical effort to get to the spot may mean his undoing. Even though the peril may lead to paralysis or death, he will take the chance for possible gain, because that luring patch on the sea bed may hold a big and fine pearl that is beyond the reach of a skin diver. Now and then an oyster will yield a pearl of great value; and even in the native markets such a pearl may sell for $1,000 or for twenty times that much. That is the reason why danger is forgotten in the quest.

"When working in the depths of the South Sea, a diver must be doubly mindful of his air hose and life line. The latter is a decidedly light rope; and either that line or his hose may be caught by a projecting coral growth and perhaps damaged if not severed. Pearl-bearing oysters are often hidden beneath some form of marine vegetation, and it takes searching to discover them in such a setting. It is then that the diver may be forgetful of his vital links with the surface vessel; and one or the other may become entangled and he exhausted by his efforts to free it. And there are still other hazards.

"Tropical waters frequently abound with sharks, devilfish, and sting rays. Many of these predatory creatures know the taste of human flesh from the toll they have taken of naked divers who must return to the surface when the air in their lungs begins to fail them. The man in diving dress, on the other hand, may play a waiting game under cover of a coral reef. He may frighten the shark away with air bubbles, or he may bide his time until the man-eater gives up the quest and swims away. However, the outcome may not be so favorable if the air line be attacked or the hose torn open by the otherwise frustrated shark. The wearer of pearls seldom if ever gives thought to the risks that have been run in harvesting those gems of the deep.

"In pearl fishing in the South Seas, I have occasionally formed a floating base for a diver and his attendant by lashing together a couple of large metal tanks capable of holding air at a pressure of 200 pounds—the tanks being charged by a compressor carried aboard our lugger. The air from these receivers is delivered to a common control point and fed thence to the worker on the sea bed by his attendant, who keeps an eye on the registering pressure gauge and on the steadily diminishing supply. This base drifts along over the fishing grounds, and the diver below, at the end of his hose, commonly trails in its wake. Several such rigs may be in use at the same time. There are places, however, where the underwater currents are strong and travel with a speed of several miles an hour. It is hard then for a diver to hold his footing, especially when both his air hose and life line also are being dragged forcibly. Over and over again such currents have balked us in deep water and

PEARL CULTURE

Near La Paz is an establishment where pearl oysters are systematically cultivated under favorable conditions both for their shells and their possible pearls. The waters of the Gulf of California yield oyster spat which is collected on traps that are placed in screened hampers and sunk in suitably protected areas so that the spat can grow to pearl-bearing size.

exhausted the divers fighting against them just when we were over a promising oyster bed. And now," continued Captain Berge, "I'll come to the point and tell you what I hope to do with the aid of torpedo air flasks.

"The problem, as I see it, is to save the diver's strength by helping him to battle with submarine currents when walking forward on the sea bed or when descending and trying to get to a given area. I believe I have devised a way to outwit the currents and to make it possible for the men to go deeper without overexerting themselves. This can be done by making the compressed air, sent down to a diver, do double duty. I have planned a rig that can be strapped low down on his back and that consists of a light air motor driving a small propeller. This personally conducted outboard motor could be brought into service as an auxiliary so as to carry a diver down and forward against a pretty stiff current, thus enabling him to reach his objective strong enough to wrench the oysters free from the sea bed or reef and to return to the surface without being dangerously overtaxed by his work. The air supply would be available both for the diver and for the motor hung on his back.

"As you can readily see," concluded Captain Berge, "I should have to have plenty of operating air, and that air should be available at a far higher stored pressure than it has been heretofore. That is why I want to buy a number of torpedo air flasks into which I can pack air at pressures ranging up to something like 3,000 pounds per square inch. So equipped, I feel sure my divers will some day garner from the sea bed pearls as big as any that have ever been harvested there. I shall then be able to fish in waters that have not been overworked and where large and perfect gems may still be in the process of making."

In the years that have elapsed since then, Victor Berge has not been idle. He has lately put his wide knowledge of pearl fishing and his resourcefulness to use for the French government in investigating the waters of Tahiti as a basis for the future control of the industry in that section of the Pacific Ocean and in the Tuamotu Archipelago, a hundred or more miles to the eastward, which has long been the source of both pearls and pearl shells of superior varieties. The exploratory work was carried on under the immediate direction of Mr. Jules Glaenzer, vice president of Cartier, Inc. That internationally known firm of jewelers has its headquarters in Paris and its American branch on Fifth Avenue, New York City.

Cartier, Inc., has for a goodly number of years specialized in pearls; and the house was among the first to send experts to the pearl fisheries and to the pearl markets of the East for the purpose of buying those ocean gems at first hand and where the choicest selections could be made. It was that ripe experience that prompted Cartier, Inc., to send a representative to Tahiti to study the pearling situation there and to offer its data so obtained to the authorities interested in France's possessions in Oceania. Papeete is the commercial port of Tahiti, the seat of governmental administration, and the place from which the pearls and the pearl shell harvested in that section of the Pacific reach the United States, London, and Paris for the ultimate adornment of those persons the world over who can afford to grace themselves with pearls, while the shells are distributed wherever needed for the manufacture of buttons, ornaments, knife handles, and what not.

Immediately offshore of Papeete there is a line of coral reefs that forms a succession of relatively placid lagoons, and it is within just such sheltered waters among the islands of Oceania that the pearl oyster propagates itself and incidentally evolves pearls when the individual bivalve is prompted to do so. Pearling in the French groups of the Pacific Islands has had its ups and downs—in recent years mostly downs. Furthermore, the oyster beds have been depleted, and the output intermittently greatly reduced by overfishing where operations have been possible for the skin diver. Prior to 1892, fishing could be done by either skin divers or regularly equipped divers, and the waters were free to anyone. In that year the authorities not only prohibited the use of diving suits but limited the taking of the pearl oyster to the island natives or other French citizens. That law has remained in force up to now. There are reasons for believing that it would be of advantage to the government and to the people immediately interested to make changes in the fishing methods and possibly to introduce some controlled system of propagation for the periodic replenishment of the beds. However, before making any decision, it was deemed essential to obtain a fuller knowledge of local conditions than could be had from native divers.

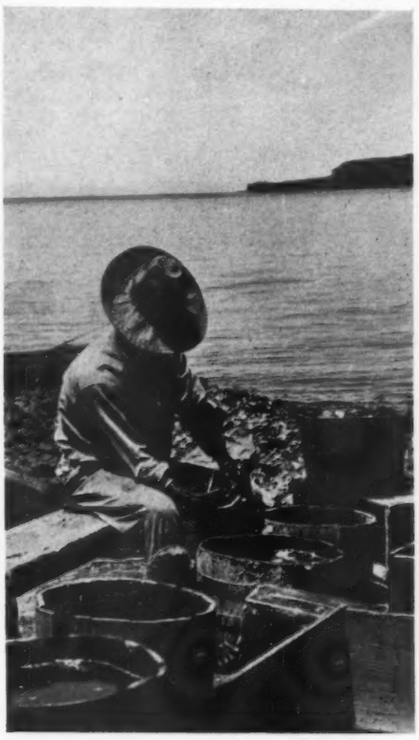
Before telling how Mr. Glaenzer and Captain Berge carried out their investigations during their four months' stay in that section of the world, it would be well to outline how pearl fishing is done among the Tuamotus, which are spread over a length of 1,500 miles and are composed of a succession of low coral islands or atolls that enclose lagoons. The Island of Hikueru is the most important seat of the pearl-shell quest, while another, 200 miles away, has long been the principal source of pearls. According to the latest available statistics, French Oceania produced six years ago, during a fishing season of six months, more than 1,136,000 pounds of pearl shell having then a market value of $104,871. No figures are obtainable concerning the value of the pearls harvested from year to year—for business reasons this is not disclosed.

Among the Tuamotus, the skin divers have no other equipment than a pair of large goggles and perhaps a light rope, with a weight of from 20 to 30 pounds attached to it, which they may use in making a descent. Some of them go down without the aid of a weighted line. In the latter case, the diver drops feet first to a depth of 10 feet, and then turns quickly head downward and swims to the bottom, in that way reaching the sea bed possibly 14 fathoms beneath the surface. Dr. Charles Haskins Townsend* has seen some of these divers remain underwater from two to nearly three minutes, crawling around on the sea bed to a distance of 60 or more feet beyond the point where they grounded. Each diver took below with him a fiber-mesh bag capable of holding from 60 to 70 pounds of shell, and to fill it he had to make several successive descents. Most of the pearl shell is harvested from depths of from 8 to 10 fathoms; and the same eminent authority says that only about 25 per cent of the 3,000 divers engaged in the work can go down more than 72 feet. Men, women, and large children do the diving.

The French arbitrarily divide the Tuamotus into three zones, and usually permit fishing in one of them each year—thus the reserve areas have recurrent periods of rest in which the pearl oysters can propagate undisturbed and grow to the permissible minimum size for taking. No oyster can be retained that has not a maximum diameter of at least 4 inches. A violation of this law invites seizure by the government and the confiscation of the wrongdoer's entire outfit and what he may have gathered up to that date.

A recent report made by a consular official of the U. S. Bureau of Foreign and Domestic Commerce contains this interesting paragraph about the pearl fisheries of the Tuamotus: "In addition to the black-lipped shell that yields white pearls, there are found in some of the lagoons 'Pipi' shell which occasionally contain rare and valuable pearls of many colors—various shades of yellow, pink, black, and, rarest of all, blue. These tinted pearls cannot be duplicated artificially or obtained by the 'culture' process, as carried on in Japan." With this background we shall be better able to understand the activities of Mr. Glaenzer and Captain Berge.

The unusual craft devised by Captain Berge for his exploratory work in the waters about Tahiti—waters that are especially suitable in numerous places for the deliberate propagation of pearl oysters—is thus described by Mr. Glaenzer: "It consisted of two steel cylinders, each about 9 feet long and 24 inches in diameter, arranged parallel to one another and holding between them a third parallel cylinder 30 inches in diameter but a little shorter than its companions. The three cylinders could be assembled by bolts and brackets so as to form a very stable catamaran of shallow draft even when full laden. A cockpit was provided in the after half of the central cylinder, while the forward half was sealed by a circular bulkhead and could be used as a receiver or tank for the storage of compressed air. In the cockpit there was mounted a small air compressor as well as the gasoline engine that could drive the compressor and the propeller shaft. The two flanking cylinders could be opened or closed by operable manhole plates, and thus could serve for the temporary storage of diving gear and other necessary equipment. Also, the opening into one of these cylinders was large enough for the passage of a man, and was arranged with suitable means of closure so that it could be employed as a hospital or recompression lock in case any of the divers were threatened with the bends."



WASHING PEARLS

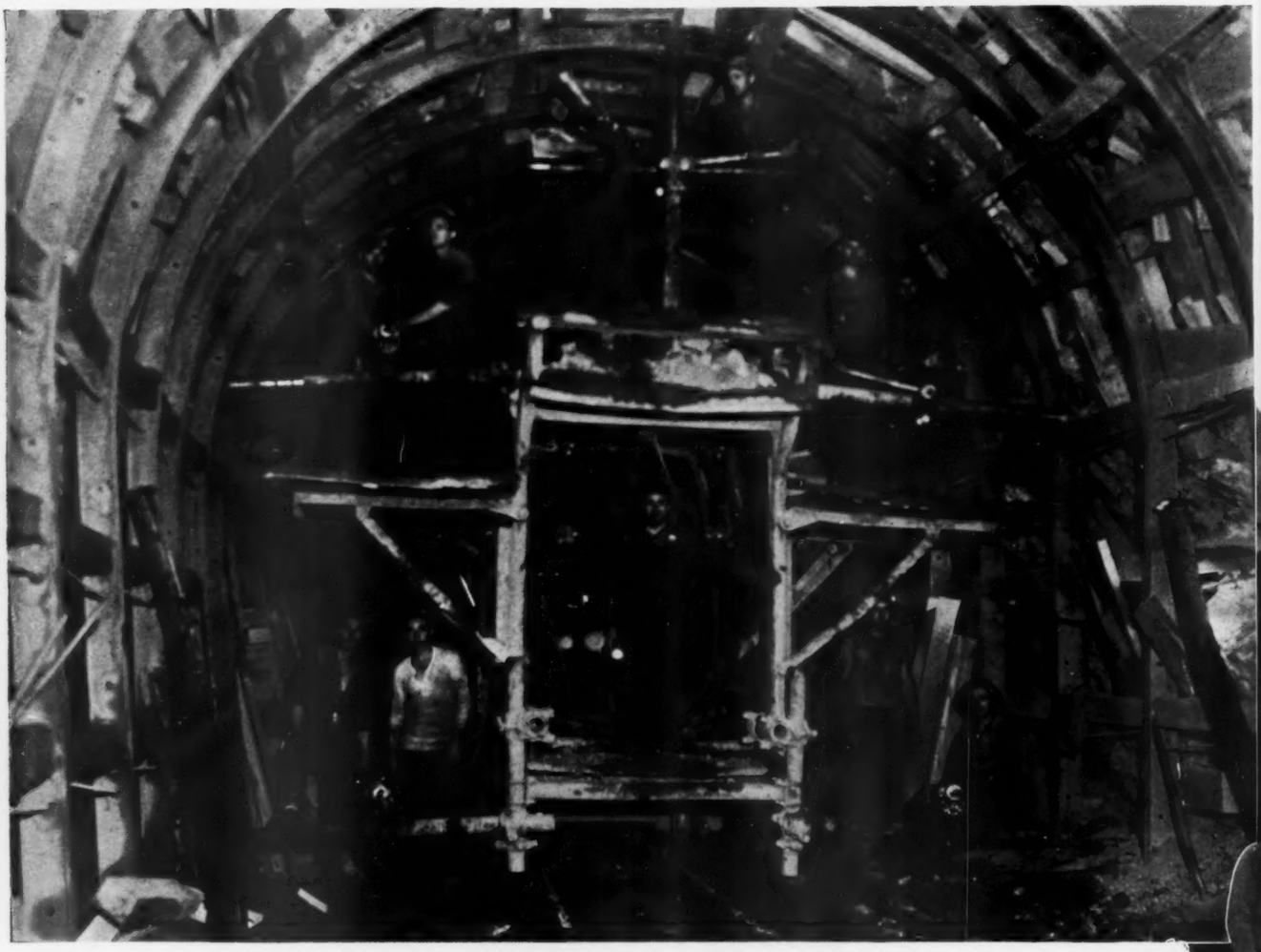
A workman at the La Paz pearl oyster "farm" washing pearl shells that have been harvested and are being made ready for the market. They are extensively used for the manufacture of knife handles, buttons, and ornaments of many kinds.

To get the catamaran into a reef-inclosed lagoon, the little vessel was dismembered, each cylinder sealed, and then placed where the breakers could sweep it over the reef into the sheltered waters beyond. When assembled for diving operations, a wooden grating was laid across the three cylinders to form a working platform; and uprights at the four corners of that deck supported an awning. To get the catamaran back into the outlying waters, the separate units were hauled through the surf by lines leading to the mother ship or sailing lugger. In the open sea, the catamaran was taken aboard the lugger; and at such times the central cylinder was utilized as an air receiver for the divers that were sent overboard directly from the large craft.

While no pearls of any intrinsic value were harvested in the waters immediately about Tahiti, nevertheless much was learned that was worth while and that would be of service in planning for the future of the industry in that part of the South Pacific. The adoption of up-to-date methods and the employment of modern apparatus on the pearling grounds of the French groups of islands may be the means of stabilizing the industry, lead to the winning of richer harvests and, at the same time, serve effectually to safeguard and to maintain the productive beds. France has every reason to be interested in protecting the source of so many of the gems that reach the great pearl market of Paris.

Captain Berge has said that the largest and finest pearls may still be found at depths of 200 feet and more—far beyond the grasp of any skin diver, and he hopes, with the aid of compressed-air equipment, to seek them and to gather them. While no one knows whence the pearls uncovered at Monte Alban, Mexico, originated, nevertheless American coastal waters have within the recorded past yielded and still yield pearls of much beauty and occasionally of great value. In these relatively nearby areas, pearls and pearl shells are recovered both by skin divers and by others using diving suits of the conventional type. Furthermore, in the bay near La Paz, Mexican experts are propagating pearl oysters. Such efforts are designed to stabilize the industry and at the same time to offset the consequences of previous overfishing. Even so, the pearl market is in no danger of a disorganizing surplus, as uncontrollable natural processes produce the pearl of great price whose luster and hue will always remain evidences of a miracle. To the pearl fisherman, each dive is a gamble, and each day's work a venture that may bring him either a trifling reward or a prize that will make him the envy of his fellows.

*Director of the New York Aquarium.



THE DRILL RIG

The view above shows the drillers at their stations, with Shift Boss A. S. Johnson in the center. At the right, standing in front of the tunnel portal, are: Superintendent J. R. Austin (center), Engineer H. E. Robinson (left), and Safety Engineer T. W. Osgood. At the bottom of this page and the facing one are close-ups of two of the five N-75 drills on the rig.

Coast Tunnelers Set New Drilling Record

ALL records for tunnel driving on the Metropolitan Aqueduct between the Colorado River and the Los Angeles district were broken during the month of November, 1935, by crews working in the 1,000 Palms Tunnel No. 1 on the Coachella Division. In 78 shifts, the heading from the west portal was advanced 1,101 feet, or an average of 14.1 feet per 8-hour shift. The tunnel is of horseshoe shape and 19 feet in diameter. Considering that it had to be supported throughout that distance by steel arches lagged with timber, it is thought that this may constitute a world record for tunneling. The November performance followed on the heels of another outstanding run during October, when 950 feet was driven in 81 shifts, or an average of 11.7 feet per shift.

Both of these marks were established with a drill rig or "jumbo" carrying five Ingersoll-Rand N-75 Auto-Feed drifter

DRILLED FINAL ROUND

The crew that holed through the 16,058-foot tunnel on December 20, 1935, after a record-breaking advance during the month of November.

drills. The accomplishment of these drills is considered somewhat remarkable in view of the fact that all of them had been in service for two years, and that they had put down many thousand feet of holes before they were transferred to this location just prior to the 2-months' run. There were nine drills available, providing four spares; but it is stated that in only a few instances was it found necessary to remove machines from the drill rig for repairs.

The tabulation of daily progress shows that 51 feet was made on the final day of the month. On each of ten days, 45 feet was drilled: on ten others the advance per day was 40 feet. The low mark was 35 feet, which was made on two separate days. On the remaining days of the 26-day working month the progress was 38, 42, and 50 feet, respectively. From the 11th to the 16th, inclusive, the daily advance was 45 feet. The consistency of this performance led one of the miners to refer to John Austin, the superintendent in charge, as "Forty-five Austin." The soubriquet stuck, and the nickname thus gained may follow the 6-foot-8-inch "super" through the rest of his life.

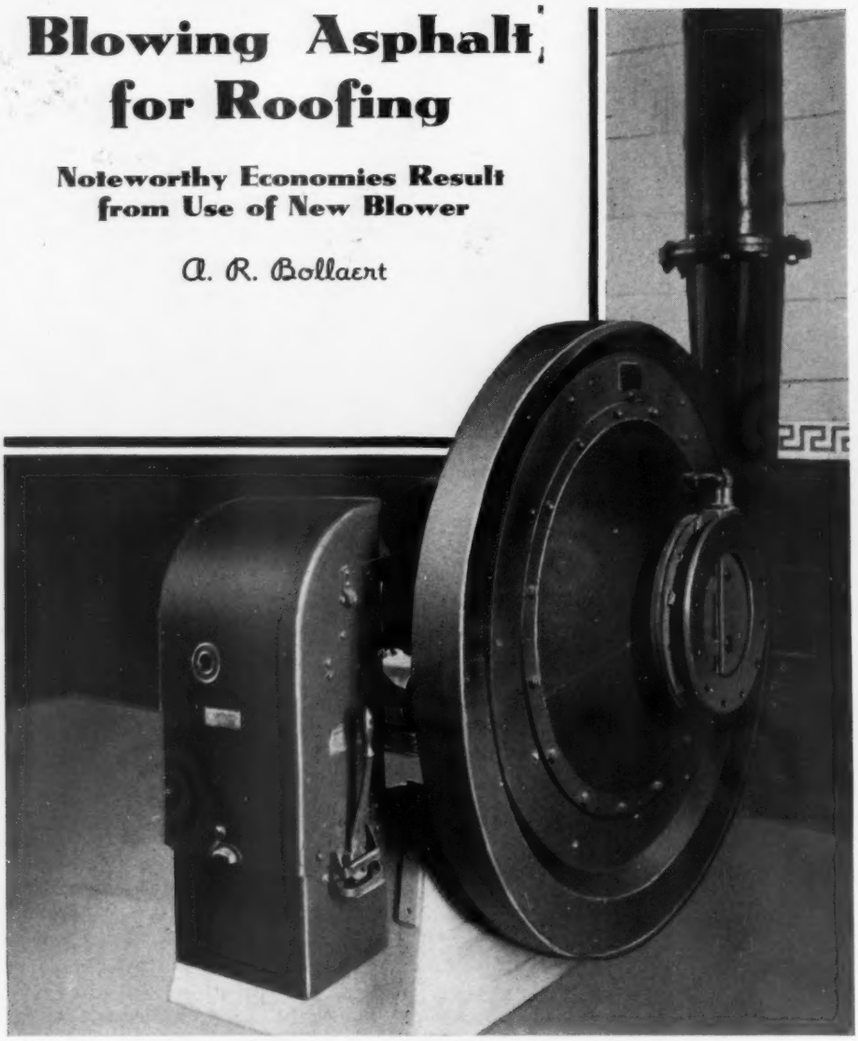
The efficiency with which the work was organized had a lot to do with making it possible to set a record. Mr. Austin at all times emphasized his desire for speed, but placed equal emphasis on safety. The schedule was arranged so that operations continued even during lunch periods. While the drillers worked, the muckers ate, and *vice versa*: on no occasion did the entire crew stop. As a consequence, lost time was held down to the lowest possible amount.

The tunnel is 16,058 feet long, and was "holed through" on December 20. It is one of 37 tunnels—having an inside diameter of 16 feet and totaling 91.83 miles in length—that are being driven as a part of the 241-mile main aqueduct which will carry Colorado River water to thirteen Southern California cities. In addition to these there are 15.69 miles of 10-foot-diameter tunnels in the distribution system of the aqueduct.

Blowing Asphalt for Roofing

Noteworthy Economies Result from Use of New Blower

A. R. Bollaert



SOURCE OF AIR

Installation view of the centrifugal machine that has shown material savings in operating costs as compared with the equipment formerly in use. It is an Ingersoll-Rand Type FS Motorblower, rated at 4,700 cfm. of air at 3.5 pounds discharge pressure. It is driven at 3,600 rpm. by a direct-connected 100-hp. motor.

ASPHALT roofing is widely used in modern buildings, either in the form of shingles or strips. Such roofing has a rag-felt base which varies in composition according to the service for which the product is intended. In the manufacturing process, the felt is passed through a saturator which impregnates it with asphalt having a low melting point. A coating of harder asphalt is then applied. It serves to seal in the softer asphalt and also acts as a binder for the surfacing material, which may be talc, soapstone, mica, or slates. Slate of variegated colors may be put on in different ways to give various attractive designs. Thus the present-day roof need not be drab. After the surfacing material has been applied, the sheets are cut into any one of a number of shingles, or wound into rolls.

The asphalt-roofing industry consumes large quantities of several grades of asphalt. Manufacturers ordinarily find it more satisfactory and more economical to produce their asphalt to meet their specific needs. It is made by oxidizing flux oil, which is the residue from petroleum after the lighter constituents such as gasoline, kerosene, gas oils, and lubricating oils have been driven off by fractional distillation. Flux oils derived from asphaltic-base petroleum give the most desirable asphalts, their chief point of superiority being their greater weather-resisting properties. Flux oils are shipped to asphalt manufacturers in tank cars which contain heating coils. Upon arrival, the contents are warmed by either steam or oil to reduce their viscosity, and are then pumped into storage tanks. The latter are also heated to condition the oil for pumping it to the shell-type stills where it undergoes treatment.

Oxidation is effected by blowing air through the oils. To facilitate this operation, two perforated air pipes enter the still near its bottom. The effectiveness of the air is proportional to the fineness of its dispersion in the oil, and the perforations are therefore sized and arranged so as to divide it into fine streams. These rise through the oil and are drawn off by a suction fan. The oil is preheated to a temperature of 350-400°F. All the additional heat that the process requires is ordinarily generated by the oxidation reactions.

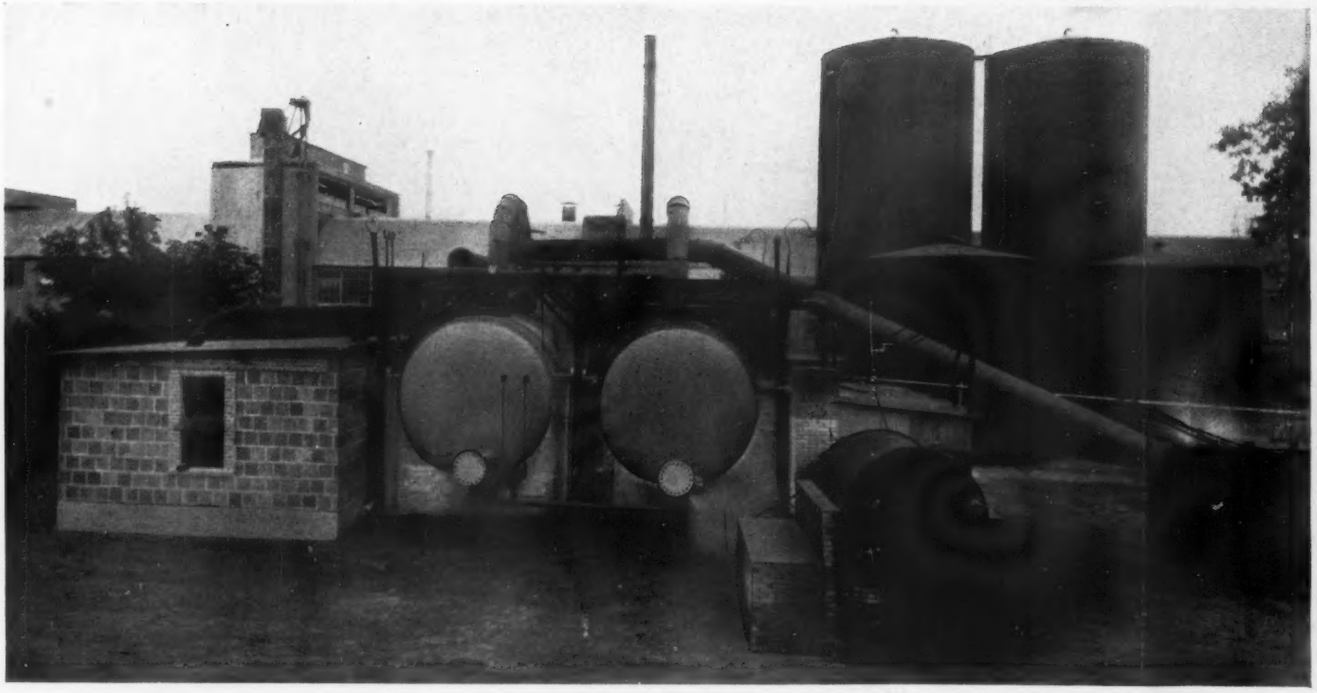
Still operators learn through experience to adjust the starting temperature so that the oil does not attain a temperature exceeding 500 to 520°F. Blowing at higher temperatures produces an inferior grade of asphalt, as well as a fire hazard. The point at which the oil will ignite spontaneously is determined beforehand in the laboratory, and steps are taken to keep the temperature below that critical point. The air pipes in the still are disposed so that the air is blown against the bottom and sides of the vessel. This prevents carbon from accumulating on the still bottom, and eliminates the possibility of local overheating.

When the blowing of asphalt on a commercial scale began about 40 years ago, three to four days of blowing time was required to obtain a product of questionable quality with a melting point of approximately 200°F. Since then much has been learned about the process, and it now takes only seven to eight hours of blowing to make a far superior product.

Under present practice, from 10 to 15 cfm. of air is used per barrel of flux oil. As a general rule, the greater the volume of air, the shorter the blowing time. When large quantities of air are consumed, the oil temperature rises very fast and approaches the danger point. To avoid possible fire hazards, it is necessary in such cases to stop blowing for several hours so as to allow the oil to cool. The use of excessive air consequently lengthens the blowing time.

Each still has its own characteristics. These the operator soon learns, and he adjusts the air and initial oil temperature accordingly. The flux oil, itself, has a decided effect upon the blowing time—in fact, oils from different wells in the same field may show slightly different characteristics. By controlling the amount of air as well as the blowing time it is possible to obtain asphalts varying in hardness, melting point, penetration, and ductility. Oftentimes it becomes necessary to blend the flux oils to achieve the desired results. Many types of catalyzers have been suggested for hastening or otherwise improving the process, but it is doubtful whether any has had commercial application. Experience shows that it is far more economical to blow air through the flux oil than to draw it through the still by means of a partial vacuum.

The Orenda Corporation, of Wilmington, Ill., manufactures Mule Hide asphalt roofing, and justly boasts of a continuous roofing process in which rags are cut at one end and the finished roofing comes from the machine at the opposite end. This concern makes all the asphalt it requires, which includes five different kinds which are used in its various products. Two stills—each



ASPHALT PLANT

General view of the Orenda Corporation's property at Wilmington, Ill. In the center are the two stills in which oil is heated and blown. The pipe leading from them to the tank at the right carries off volatile matter for condensation. In the background are storage tanks for oil and asphalt. The blowing equipment is in the small building at the left.

having a charging capacity of 15,000 gallons—with a centrifugal blower as a source of air and an older blower for standby service constitute the asphalt-manufacturing unit.

Early last year, the centrifugal blower was installed. It is an Ingersoll-Rand Motorblower having a maximum capacity of 4,700 cfm. at 3.5 pounds discharge pressure. It is driven by a 100-hp. motor directly connected to its rotor. The volume of air delivered is regulated by a blast gate at the intake. This machine has many advantages over the previously used blower that now serves as a standby.

Although it delivers a greater volume of air, the new unit uses only 82 hp., as compared with 112 hp. for the older blower. This reduction of 30 hp. results in a power saving of 22½ kw. per hour. As about 8½ hours of operation are required to blow a still of coating asphalt, the total saving amounts to 191 kw-hrs. However, the greater air delivery of the Motorblower has made it possible to cut down the blowing time for certain types of asphalt from 8½ to 6¼ hours. Calculations show that in such cases the power saving is 366 kw-hrs. per batch. It takes around 21 hours to load a still, heat the oil, blow it, and unload the asphalt. Figuring a day's production at 1¹⁄₁₀ batches, the saving for 24 hours amounts to 403 kw-hrs. of power.

It should be noted in this connection that it is sometimes desirable to reduce the volume of air. The operating characteristics of the Motorblower are such that a decrease in the air supply results in a proportionate reduction in the power input.

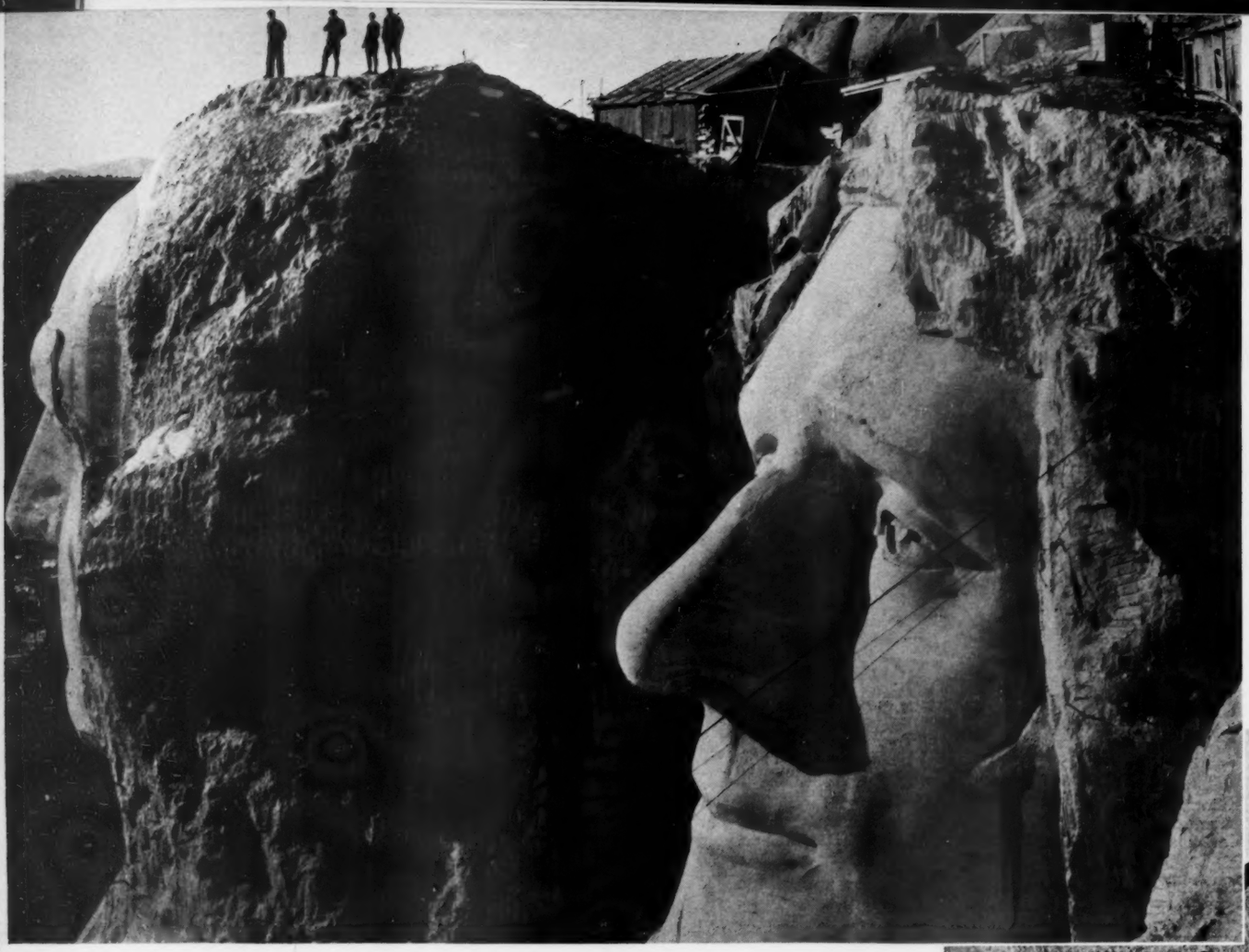
In designing a plant of this kind, both the frictional losses and the depth of the oil must be accurately determined. The centrifugal blower will not deliver against pressures much greater than its rated maximum. The best practice seems to be to design a unit having a minimum amount of friction. This necessitates large air pipes without sharp bends, as well as numerous perforations in the pipes in the still. After the frictional losses have been carefully ascertained, a blower unit capable of delivering against that pressure, with a substantial safety factor added, can be specified. It is of course obvious that the lower the working pressure, the smaller will be the power costs.

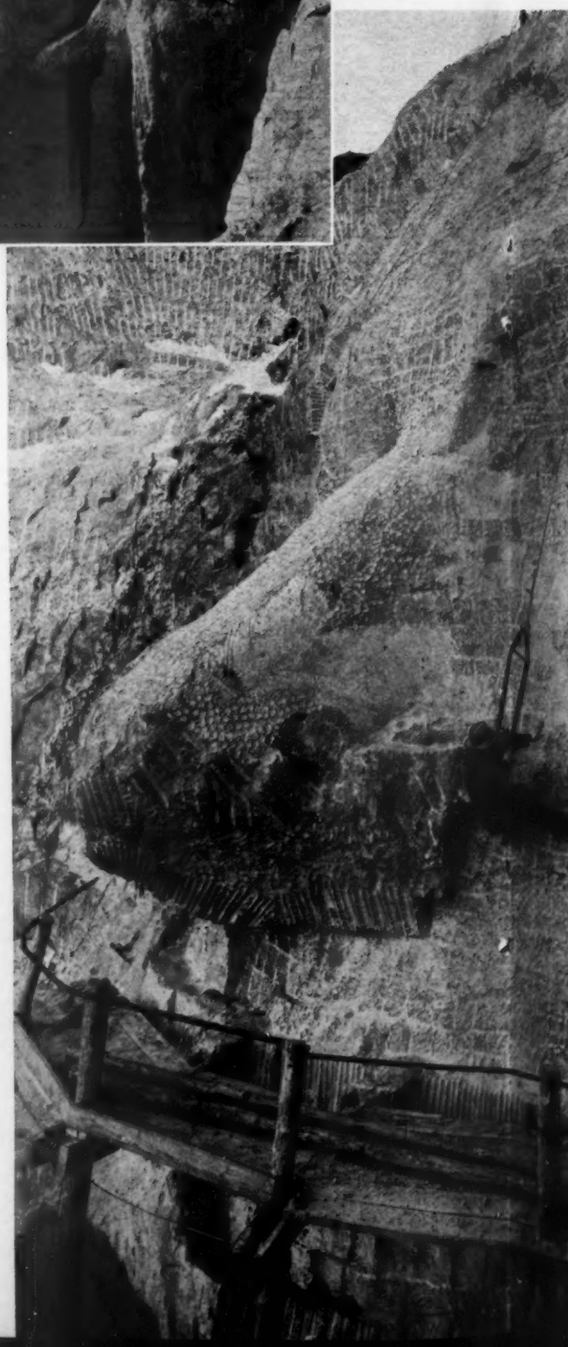
Resin-Impregnated Wood a New Product

BY MEANS of a process somewhat akin to that used in creosoting timber, wood is being impregnated with resin to give it characteristics that, it is believed, will measurably increase its field of application. The product is said to combine the advantages of plastics and wood, and can be varied according to the use to which it is to be put. When it is to be fashioned into golf-club heads, for example, maximum hardness, resilience, and resistance to abrasion are required; the wood for baseball bats must not chip nor split; and that for airplane members must be light, flexible, hard, and proof against moisture and abrasion. All these qualities, it is claimed, can be retained and imparted by the new process, which has been developed by the Pyratone Products Corporation of Chicago.

The basic material used in the Temp-Urd Wood process, as it is known, is a synthetic resin of the phenol and formaldehyde condensation type, and the treatment is essentially as follows: The wood is first subjected to a vacuum, and then submerged in the fluid resin—impregnation being effected with air under pressure. After that the timber is cured for a period of about 100 hours at a temperature of 200°F. If a glossy surface is desired for such articles as bowls, trays, handles, etc., the process is repeated. This time the resin remains on the surface, as the cells are already filled, and gives a beautiful transparent finish that brings out the grain. The coated product can be sanded and polished without destroying the film. Wood so treated is said not to swell, warp, nor become otherwise distorted when exposed to moderate moisture changes. In fact, experiments have proved that wood both impregnated and coated with resin absorbs a normal moisture content of 8 per cent only after six weeks of complete immersion in water.

The process has reached a commercial stage, and is now being employed by several sporting-goods manufacturers in the making of tennis rackets, polo balls, mallets, fishing rods, baseball bats, golf-club heads, etc. It is also being tested for use in connection with the manufacture of airplanes, musical instruments, patterns, bobbins and shuttles, and numerous other commodities.





Mount Rushmore Memorial Takes Form

IT IS said that no statue, no enduring memorial of any kind that is directly traceable to the American Indians has ever been found. That is one reason why we know so little about their antiquity. The present tenants of what is now the United States differ from the original occupants in that regard, for like most people since the dawn of time we are distinctly memorial-minded. If, from some cause, America should become depopulated and be rediscovered centuries hence, archaeologists who might dig in our soil would be able to unearth a fairly complete history of our activities.

Of transcending interest no doubt would be the cluster of huge granite heads that they would find hewn in a granite cliff in the north-central West in a section which, they would discover, had been called South Dakota. This heroic carving, the largest piece of sculpturing ever attempted, is designed to perpetuate the memory of four outstanding presidents—Washington, Jefferson, Lincoln, and Theodore Roosevelt. On a tablet flanking the four heads will be graven a 500-word history of the United States composed by a fifth president, Calvin Coolidge.

Nine years have elapsed since Gutzon Borglum began work on this colossal memorial on Mount Rushmore. Progress has been slower than was expected mainly because sufficient funds have not been available, but the pictures on this page give evidence that the group is taking form. Mr. Borglum continues to direct the operations; and, despite his 68 years, he travels agilely over the face of the sheer cliff in a boatswain's chair to supervise and to inspect the efforts of the human flies that shape the contours of the gigantic figures with air-driven tools. He is the lowest of the three men shown immediately to the right.

A detailed description of the methods by which the carving is being done appeared in Compressed Air Magazine for November, 1930.

In the foreground of the view at the upper left is the head of Jefferson and, beyond it, the head of Washington, which was the first to be carved. The black streaks were caused by melting snow. The center picture shows workmen completing the details of one of Jefferson's eyes. The other two views are close-ups of drillers putting in blast holes with "Jackhamers" to rough out a head.

Photographs from Publishers' Photo Service

Thirty Years of Canadian Mining

The Newer Gold Fields—Part 2

R. C. Rowe

NORTHERN GROUPS

Above are two prospectors in winter accouterments. At the left is the development crew at a new mine. Nine of the men are each holding a husky puppy.

III

CONSIDERATION of the next of the new gold fields carries us westward and south from Red Lake into the general area where all the activity mentioned in the early part of the chapter occurred. We refer to Little Long Lac, which is located in the Port Arthur Mining Division of the Province of Ontario.

Little Long Lac—so called to distinguish it from Long Lac—is close to that branch of the Canadian National Railways that runs from Port Arthur to the main transcontinental line lying to the north. It is a typical northern lake with a singularly winding shore line and long narrow arms or bays. The region is somewhat unique in that it was almost unnoticed until it sprang into prominence during 1932. This is all the more remarkable when it is remembered that an important discovery made near Kowkash as far back as 1915 resulted in somewhat of a rush, the evidences of which survive today in the existence of the Tashota Mine. Much about the same time gold was found at Beardmore; and the Beardmore property now operated by the Newmont interests is one of those original discoveries. The Little Long Lac district, however, remained dormant until Tom Johnson and Tony Oklend located what is now known as Little Long Lac Gold Mines.

JOHN E. HAMMELL

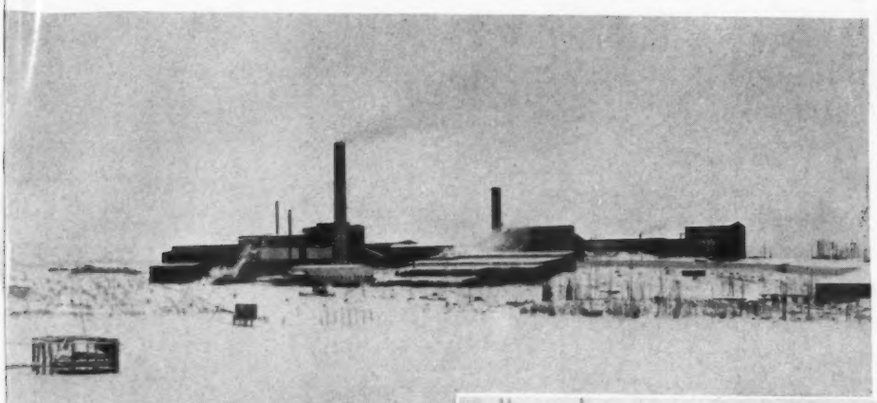
The name of this man has appeared often in this narrative. The informal picture was taken at Beaver Lake about the time of the Flin Flon discovery, some 20 years ago.

The writer has among his historical records a letter from one A. J. Gagnon, who claims to have been in the Little Long Lac area in 1914. He found "a little gold" there, not enough to stir the blood to fever pitch, but enough to intrigue the fancy and to rivet his attention on the geological features of the district. He "was delighted with the rock formation"; but the World War was upon us, and men were concerned with far more momentous things than the doings of a man who had found a little gold at Little Long Lac.

And so the years passed and the World War passed with its "spirit of gallantry and courage that made a strange Heaven out of unbelievable Hell" (these words are not Gagnon's, but belong to Noel Coward), and the man who had found a little gold around the shores of Little Long Lac peddled his story to sundry and many people, but no one had the money or the confidence to send him back. Even if they had, it is hard to say whether the course of history would have been changed. In any case, it does not matter, for in the end Gagnon became interested in other things and forgot Little Long Lac until the two men already mentioned brought it to the attention of the world.

The first discovery in the region was known as the Smith-Watson. It was made in 1931. In September of that year Tom Johnson—one of the new type of prospectors—heard of the Smith-Watson find, and finally left Tashota with Bob Wells to go to Little Long Lac. (The writer is referring to Johnson's personal narrative given in 1934.) They arrived on October 1. On the third they staked eighteen claims on showings located in the lake. These claims were later drilled, but did not prove up.

Early in 1932 Johnson was back in the country, and made the discoveries on Magnet Lake that afterwards became the Bankfield property. About the end of June, Johnson and Oklend arranged a further prospecting trip to Little Long Lac. They went down Magnet Creek to the west arm of Little Long Lac, and from there to the main part of the lake. They then examined a spot where Oklend had panned a considerable amount of gold some time previ-



FLIN FLON

Legend has it that this euphonious name was that of a Chinese cook who accompanied one of the early parties that investigated the claims which have been developed into one of Canada's outstanding base-metal mines. Shown here are a general view of the surface plant and a glimpse of the huge open pit at one of its narrowest points. Note the electric haulage locomotive.

busly, and Johnson obtained some values from panning a small shearing just north of a shallow pit that had been sunk by some other claim owner. Next they proceeded to Boulder Lake, and eventually returned to the west arm of Little Long Lac where, to quote Mr. Johnson: "I suggested to Oklend that we get an old shovel that I knew of and put a long handle in it and go to the main narrows and do some testing farther out in the lake."

That little touch about the shovel is interesting because it shows two things: first, that work had been done there at a number of places—the shallow pit at one point and the shovel at another being proof of that; and, second, that Johnson knew the country intimately. Those that have followed this history will have observed that in all the fields we have traced there were evidences of previous work; and there is something rather pathetic about them. For example, the pit on the Hollinger property a few feet from the spectacular surface showings that made Benny Hollinger's eyes glisten; the samples that originated at Lake Tremoy; the shallow shaft near the Howey; and the shallow pit and the old shovel at Little Long Lac—all proof of effort that was in sight of fortune and yet came to nothing.

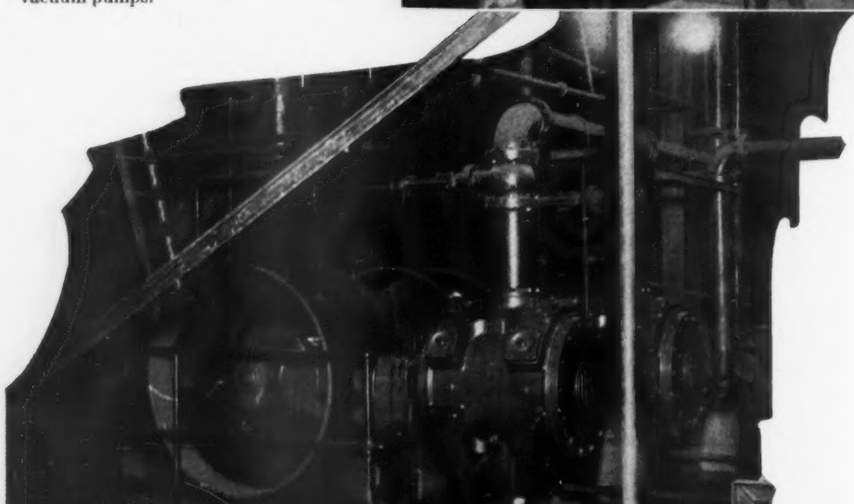
Returning to Johnson and Oklend, we learn that they headed for a shearing that the latter remembered having seen. It was while they were looking for it that Johnson noticed some pieces of quartz on the lake bottom close to the shore. He told his companion to stop paddling so that he could examine the quartz. Oklend, having the shearing in mind, objected; but Johnson finally had his way and stepped out of the canoe into about 18 inches of water. The third piece that he picked up had a small showing of free gold; and in less than an hour the two men had about 20 pounds of quartz bearing visible gold. They then proceeded to stake; and the Little Long Lac Mine was the outcome.

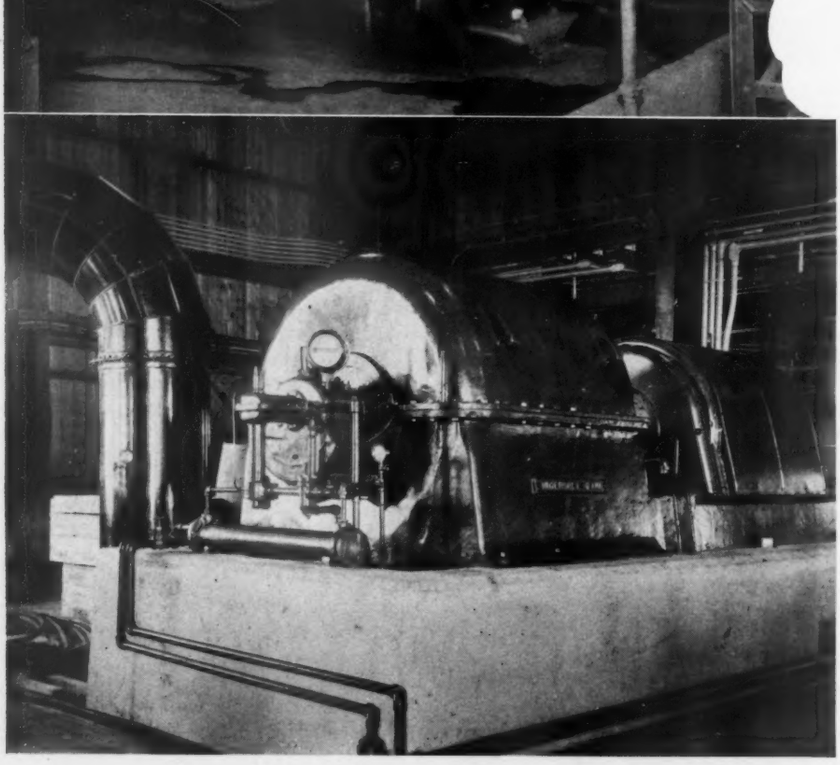
As soon as staking was completed, Johnson sent samples to Percy Hopkins, the well-known geologist who showed them to Mr. Fitzgerald and J. Errington of the Sudbury Diamond Drilling Company, both of whom had a hand in many mining projects. They were evidently impressed, for they worked fast—wiring A. A. Barton, their engineer, who was making some investigations in northwestern Ontario, to examine the property. Mr. Barton arrived promptly, and left after a day or two only to return in three days accompanied by Percy Hopkins. The upshot of these movements was that Hopkins took an option on the property; but later advised the partners that Mr. Errington was coming to look it over and that if they could make a deal with him that it was all right to go ahead. On August 8, Errington took an option which was exercised in its entirety.

The rest is a story of steady progress. Errington seized upon the venture with that vigor for which he is so justly famous. At first he called it his "vest-pocket mine"; but, as the picture of it unfolded with underground work, it soon became obvious that the Little Long Lac was no small affair. The vein, which at surface was narrow, widened with depth and displayed remarkable values that ran from ¾ to more than 1 ounce of gold per ton. Development was pushed at a rapid rate, and the mine came into production early in 1935. Now the property is bidding for place as one of Canada's major gold producers.

We have pointed out several times in the course of this history that discoveries in one area always serve as a jumping-off place for further exploration, and Little Long Lac was no exception to this rule. With the finds of Oklend and Johnson, Little Long Lac became a center of tremendous activity. Claims were staked far and wide, and hopes ran high. As ground was taken up, late comers had to move on, and eventually some of them went westward to the Sturgeon River where other discoveries were made.

Following close upon Little Long Lac, Sturgeon River had a great deal of attention focused upon it. The older camp had,





EQUIPMENT AT FLIN FLON

The plant includes complete facilities for mining, milling, and smelting the complex zinc-copper-gold-silver ore. For blowing the copper converter there is installed the turbo-blower seen in the bottom picture. It has a capacity of 20,000 cfm. at 16 pounds discharge pressure. The other views show a section of the machine shop, and two straight-line, belt-driven vacuum pumps.

in a way, crept up upon the world, and it was well embarked upon development before the spotlight of publicity was turned upon it, with the result that it was a sort of anticlimax. Sturgeon River, which jumped into public view just about this time, was promptly brought into the limelight, and enjoyed or suffered (it depends upon the viewpoint) a rather hectic boom. Enthusiasm knew no bounds, and once more the familiar cry was heard, "Here is a second Porcupine." Today the boom has receded, and the hopes of a second Porcupine have faded; but steady work goes on. While the district is not yet a producer, it will in days to come probably help to swell Canada's gold output.

IV

AN ACCOUNT of the most westerly of the new gold fields in eastern Canada carries us into northern Manitoba, and we can hardly venture into this region without touching upon its copper mines. One of these is the great Flin Flon Mine, of the Hudson Bay Mining & Smelting Company, Ltd., which has become world famous and which is producing steadily. In a manner of speaking, the story of Manitoba copper is a story unto itself; but as it is definitely linked with the events of this history, it must be included here.

The copper area of Manitoba lies approximately 100 miles north of The Pas, which in its turn is 482 miles north of Winnipeg by railway. It is at the western extremity of the province, in fact, a part of the huge Flin Flon ore body lies in the neighboring Province of Saskatchewan. For a good many years railway communication with the northern section of Manitoba terminated at The Pas, and the vast region north of this town remained practically unexplored except for such spasmodic expeditions as men undertook for various reasons of their own. Later, however, there was planned the Hudson Bay Railway,

THE PAS, MANITOBA

An aerial view of the city from which a connecting railroad was built nearly 100 miles to the northward to make it possible to develop the Flin Flon Mine. By rail The Pas is 482 miles from Winnipeg.

which was to run north from The Pas to Hudson Bay where a port was to be established. The object of this ambitious venture was to provide a northern outlet and a reduced rail haul for the great crop of western grain.

It will be remembered that this story opened with the project of a northern railroad, the Temiskaming & Northern Ontario, and it will be recalled that the idea encountered terrific opposition. We have also mentioned how the railway into Rouyn met criticism and prophecies of failure. That seems to be the fate of pioneering railroads; and the Hudson Bay was no exception. The proposal raised a storm of controversy that had rather bitter political reverberations; but in the end the railway was started. It is true that its construction suffered pauses and halts, and it was many years before it was completed; but the prospect of it, and the slow pushing forward of railhead, stimulated exploration of the country through which it was to pass.

Thus, in 1914, a lot of prospecting was being done north of The Pas, and its sole aim was to find gold. Some of the men active in those days were Thomas Creighton, the Mosher brothers, Leo Dion, and G. Reynolds. Two of the outsiders attracted to the general district were J. E. Spurr, formerly editor of *Engineering and Mining Journal* and at that time geologist of the Tonopah Mining Company, and John E. Hammell, with whom we are already familiar. These two men were to have a prominent part in subsequent events.

Creighton and one of the Moshers had done some prospecting in the area and had already staked several gold claims; and it was in 1914 that Creighton noticed a rusty hummock or rock on the shores of what was then an unnamed lake. In 1915, in company with John Mosher, he returned to the spot for no particular reason except that the rusty outcrop remained in his mind, all of which is curiously reminiscent of Edmund Horne and the rusty outcrops on Tremoy Lake in northwestern Quebec. They panned some of the gossan and got gold values, and immediately proceeded to stake. Thus the first impression of Flin Flon was that it was a gold mine; but trenching later on caused a revision of this opinion. It was at this juncture that Hammell appeared on the scene. He was in the region with his wife looking over a gold prospect, and he had a grubstake interest with Creighton and Mosher. After examining the property, he undertook to arrange for its development, and further guaranteed the discoverers a high recompense therefor, all of which promises he kept.

The first step in the long sequence of happenings which ultimately resulted in the present great enterprise was the acquirement of an option on the property by Messrs. Hayden, Stone & Company, which started diamond drilling in the spring of 1916. Meanwhile, a large section of the country was staked, and it attracted a good deal of attention because of the finding of Flin Flon and of the Mandy Mine lying roughly about three miles almost due south.

The Mandy was discovered in the autumn of 1915 by George Reynolds, who was grubstaked by one Jackson. The claims were immediately visited by Spurr, who was in the locality looking over other prospects. Upon examination, he at once advised his principals to option the property, which they did; and in the spring of 1916 was set up the first diamond drill in northern Manitoba. By midsummer the ore body was entirely blocked out. It was a comparatively small lense of about 205,000 tons; but it was remarkable because it contained a core of about 25,000 tons of massive chalcopyrite averaging more than 20 per cent copper. As copper was selling at 26 cents per pound in those far-off halcyon days, it was decided to mine and to ship the ore to Trail.

This was no small undertaking in view of the fact that the property was 80 miles from a railway, but operations were begun in January, 1917. In three months 80 miles of winter road was cut; buildings were erected; machinery transported to the mine; and 3,800 tons of ore taken from an open cut and hauled to the railway for shipment to the smelter of Consolidated Mining & Smelting Company of Canada, Ltd., at Trail, B. C. In addition to these accomplishments, a shaft was started. Mining went on steadily for three years, and transportation for four. The last productive work was terminated in 1920, and the mine has yielded nothing since then.

While these events were transpiring at Mandy, the Flin Flon was busy making history. Diamond drilling by Hayden, Stone & Company disclosed that the ore body was very complex in character and that values were somewhat low for a prospect situated so far from railhead. They did not, therefore, exercise their option.

In the spring of 1917, Toronto interests optioned the property and carried out about 18,000 feet of diamond drilling. For this they secured a 32 per cent interest in the Flin Flon, which was again optioned in 1920 by Col. William Boyce Thompson and the Mining Corporation of Canada, Ltd. The latter sank two shafts and did a large amount of underground work, with the result that some 18,000,000 tons of ore was indicated, running 0.074 ounce of gold, 1.06 ounces of silver, 1.71 per cent copper, and 3.45 per cent zinc. It was obvious, however, that the ore was such that large-scale operations were imperative, and that a concentrating plant, smelter, and refinery would have to be located at the mine. Naturally, operations of such a magnitude could not be conducted without railway facilities; and there the matter rested. The property remained idle until 1925, when the Harry Payne Whitney group entered the picture and Flin Flon started upon that phase of its history that led eventually to production.

SAN ANTONIO MINE

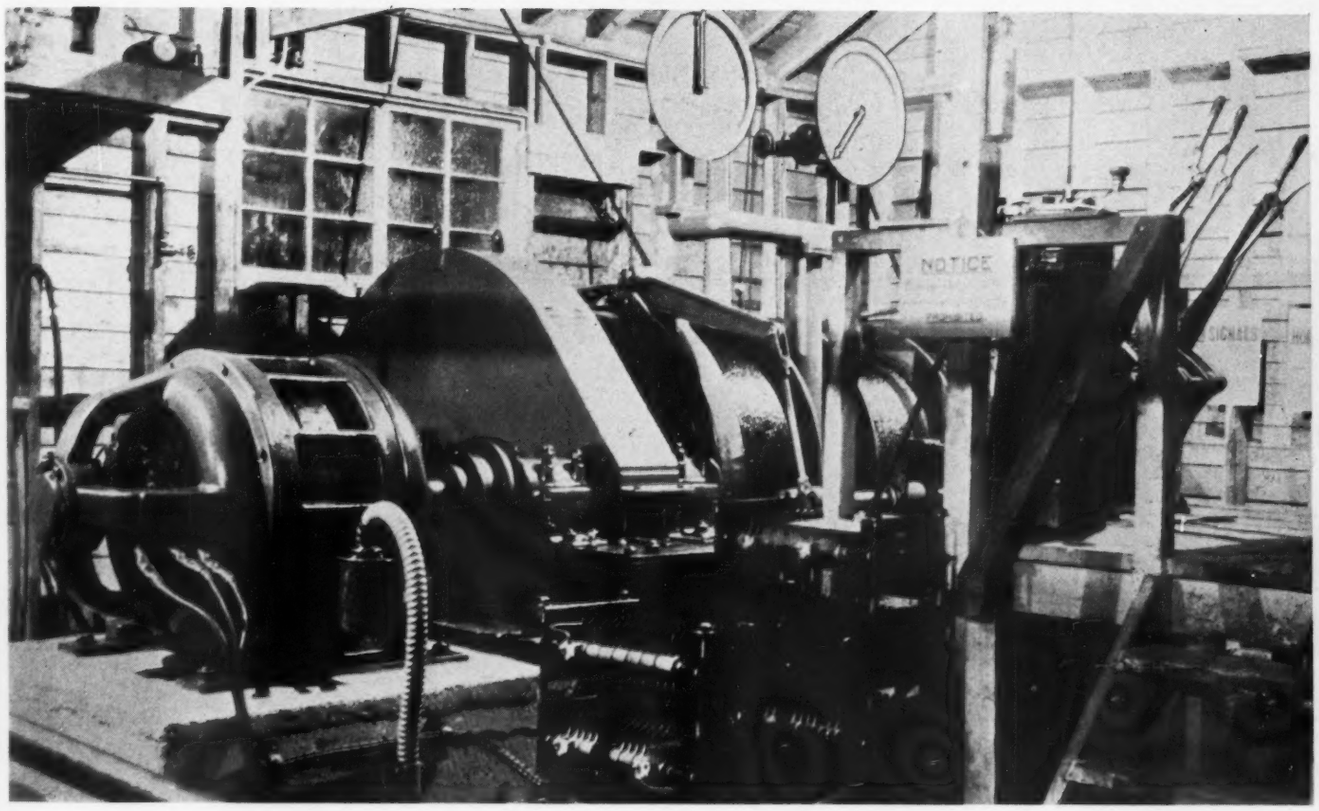
A night view of Manitoba's first dividend-paying gold mine. Maj. A. E. Pelletier discovered this property after he had resigned as an inspector of the Canadian Mounted Police to become a prospector. The picture on the opposite page shows a Canadian Ingersoll-Rand Company double-drum hoist that was installed at this mine in 1932. It is driven by a 75-hp. motor. The San Antonio is in the Rice Lake region, one of the newer and very active gold fields.

Somehow or other the property was brought to the attention of R. H. Channing, Jr., who was then in charge of the mining activities of the late Harry Payne Whitney, and he became interested in it to the extent of getting permission from the Mining Corporation of Canada to dewater the workings and to sample the ore bodies. This was done by R. E. Phelan, who has managed the mine since. In consequence of the sampling, an option was obtained from the Mining Corporation and from A. Fasken, then owners of the property. Then began a long series of tests upon the ores, and the general principles of treatment were laid out. It would take far too much space to give details of the thoroughness of these tests. The ores are very complex, and the problem of their efficient concentration was a difficult one. It was a long road before it was solved to the satisfaction of the investigators. Even when it was felt that the great ore body could be successfully handled, there still remained the all important matter of transportation. It too, had to be solved before further steps could be taken. Negotiations were opened with the Government of Manitoba, which finally agreed to guarantee the bonds of a line from the Hudson Bay Railway to Flin Flon provided the development of the property was in the hands of financially responsible parties. As that was the case, the last obstacle was overcome, and the way to ultimate production lay open.

With these preliminaries concluded, work at the mine was promptly started, and a pilot mill was erected. In December, 1927, the property was taken over by Hudson Bay Mining & Smelting Company, Ltd., which was incorporated for that purpose. Railway building began in January of 1928. On March 1, 1929, the first pick was driven into the ground for permanent construction, and in July, 1930, the first ore passed through the crushers. The amount of work completed in this period was extraordinary. A 3,000-ton concentrating plant was built, and a copper smelter and a zinc refinery installed, together with all the necessary surface equipment such as machine shops, storehouses, camps, and a town for employees. In addition, a hydro-electric plant was erected at Island Falls. This deserves more than passing mention because Island Falls is situated some 70 miles from Flin Flon. Therefore all the heavy equipment needed had to be hauled from the mine to the power-house site through the virgin bush.

During the winters of 1928-29 and 1929-30 about 36,000 tons of freight was handled between Flin Flon and Island Falls. This was accomplished by one of the most spectacular tractor movements ever undertaken. A fleet of twelve 100-hp. Linn tractors was employed, and each pulled great trains of special 60-inch-gauge sleighs overy icy roads. Day and night these tractor trains shattered the winter silences of the northern woods; and as one contemplates this mechanized movement of freight, there comes into mind a picture of the winter road into Porcupine which has been described elsewhere in this chronicle. The latter was in the age of the horse and the teamster, while that into Island Falls was a road of machines. One was musical with the jingle of trace chains, while the other was a cacophony of sound with the staccato roar of motor exhausts. As we compare the two, the tremendous difference in them brings home to us again the progress of the years and the march of events.

Before passing from this brief history of the Flin Flon, the splendid record of the Hudson Bay Mining & Smelting Company must be mentioned. Flin Flon came into production when the depression had just got nicely started. The company was faced with falling metal prices and unprofitable operation. It was, however, keenly alive to certain responsibilities that had been thrust upon it by conditions over which it had no control. The isolated position of the property had resulted



in the building of a town that was utterly dependent upon the mine in every phase of its economic and social life. Thus a cessation of activities would have brought destitution upon the residents of Flin Flon. Businesses would have perished and the Province of Manitoba would have had to transfer the individuals to other places which, owing to the universal depression, would have been quite unable to absorb them.

To the everlasting credit of the Hudson Bay Mining & Smelting Company, it can be recorded that it continued operations all through the days of low metal prices without profit to its shareholders; but in so doing it maintained its isolated community. Only the finest public spirit and the highest efficiency could have effected this during a period which struck a staggering blow to base-metal mining throughout the world; and Manitoba owes a great debt to the directors of the company and to R. E. Phelan, its general manager. The company paid its first dividend in 1934.

During the time when Flin Flon was being developed, there was naturally a good deal of activity in the surrounding country, and prospectors spread far and wide. One of these was Carl Sherritt, formerly a laborer on the Hudson Bay Railway, who was destined to give his name to a big mine. For some reason or other, which will probably never be known, he penetrated north as far as Cold Lake (which is a translation of the Cree name of Kissising), where he found certain outcrops which, so it was later determined, carried copper. Operations at Flin Flon as well as in northern Quebec had made people very copper-minded, and as a result it was not difficult to interest money in discoveries such as those uncovered by Sherritt. J. P. Gordon of The Pas immediately associated himself with Sherritt, and thus the Sherritt-Gordon Mine came into being.

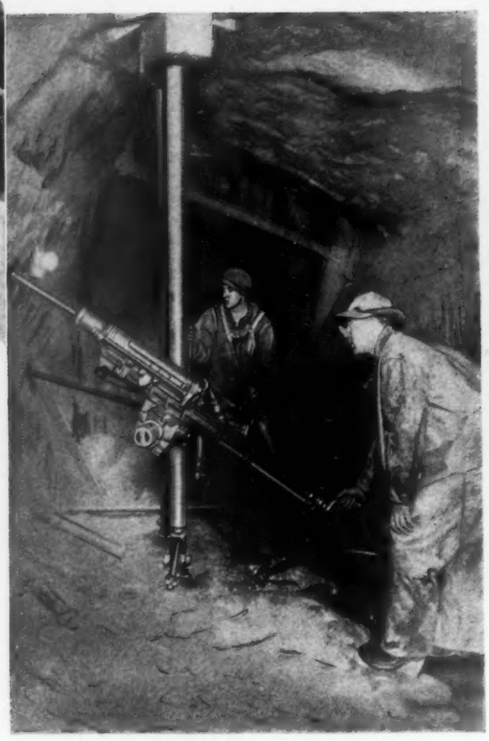
Into the picture then flashed R. Jowsey, whom we have already noted in connection with the finding of the Keeley silver mine, and who was going to be conspicuous in certain matters which we have yet to relate. Jowsey, with that forthrightness that has made him famous, interested Ventures, Ltd., in the property, and Sherritt-Gordon Mines, Ltd., was incorporated in 1927. A steady development campaign was carried out under the management of Eldon Brown, and the mine was provided with a mill and came into production in 1931. Concentrates were shipped to the smelter of the Hudson Bay Mining & Smelting Company at Flin Flon.

Owing to the low price of copper, the property was closed down in 1932, and has not been reopened since then. Buildings and equipment, however, are being carefully maintained, and a resumption of operations only awaits higher copper prices and a stable market. Meanwhile, some time before the Sherritt-Gordon became a producer, Carl Sherritt became a wealthy man; but that restlessness which led his wandering feet to Cold Lake and which made him a successful prospector, prevented him from settling down to a quiet existence. He turned his attention to aviation. Doubtless in his foot-slogging days he had often watched and envied the grace of planes gliding along the invisible windways of the northern skies, and money gave him an opportunity to indulge his fancy. He qualified for a pilot's license and bought a plane; but his newfound freedom was short-lived, for he crashed and was killed soon after.

V

FOLLOWING this excursion into the realm of copper, we may return again to the consideration of gold, and once more we have to glance back into the past before turning definitely to the new. This time we are to note the activities of Maj. A. E. Pelletier, who has had a colorful and varied career. Major Pelletier was a veteran of the Boer War and finally became an inspector in the Royal Canadian Mounted Police. In 1911 he resigned from the famous force and went prospecting, which is a bald statement covering a rather momentous step in a man's life. It was, however, a very successful step, for in the same year he wandered into the Rice Lake region where he staked three claims. One of these later became the San Antonio Mine, which eventually became Manitoba's first dividend-paying gold mine.

But years elapsed between discovery and dividends, and many of these were discouraging almost beyond measure. It took a long time to solve the riddle of the



SINKING AND DRIFTING

Just above is a shaft-sinking crew at Flin Flon using X-59 "Jackhamers." At the right are two drifter drills at work on a Manitoba property. In the top picture is a team of oxen that was used for heavy hauling in northern Manitoba before tractors were available.

San Antonio; and it probably never would have been solved but for John Reid who is one of the best known examining engineers in Canada.' He made a very careful report on the mine about 1929 (the writer is depending on his memory now, and the exact date is a little uncertain), and it was on the strength of that report that the Timmins interests advanced the money which carried the San Antonio through to success. Dividends were first paid in 1934.

This is just another interesting example of the influence that the older camps in Ontario have had upon mining over all of Canada, and it is the second time we have recorded Porcupine money coming to the rescue of mining properties in other parts of the country. The whole Rice Lake area has since become very active, and while it is old in the matter of years it may be classed as one of the newer gold fields. This, in turn, brings us to the consideration of the newest, which basks in the glory of the picturesque name of God's Lake.

God's Lake lies east and somewhat north of the Rice Lake region, and is comparatively close to the Manitoba-Ontario boundary. The whole area in which it is located has had some attention for years. Situated as it is within reasonable distance of Rice Lake, it was inevitable that the venturing, wandering feet of men should stray there in an endeavor to duplicate the finds in the older district. As a matter of fact, the God's Lake region was by no means untrodden ground, as it lay in the general path of the fur route from Hudson Bay to Norway House at the northern end of Lake Winnipeg. For 200 years, at least, this route had been traveled by men engaged in the fascinating fur trade; but they had no eye for mineral, and it was not until 1918 that the first recorded gold discovery in the area was made at Knee Lake by Harold Paull. The result of this find was a geological survey by Dr. J. F. Wright, whose report was eventually published. At this point we might quite profitably digress to pay proper tribute to the geological surveys of the Dominion Government and to the several provincial governments, notably Ontario and Quebec.

The officers of these various government surveys have for many years been indefatigable in their efforts, and the mining industry of Canada owes them a debt that is too seldom properly assessed and most certainly can never be repaid. There is hardly a foot of the great Northland which has not known the tread of their feet, and there are very few waterways which have not borne their questing canoes. Quietly and without personal profit, except that born of a sense of accomplishment they have read the rocks and put their findings in reports and maps for the benefit of all men. Again and again they have pointed the way, and then have gone to other places—always in the lead, and sometimes many years ahead of the ultimate discoveries.

The service of the geologist has never been better exemplified than in the case of God's Lake, because it was Doctor Wright's report that finally made no less a person than Robert Jowsey turn his attention to the region. As we have seen in this chronicle, Jowsey is a man of no ordinary attainments. He first came to our notice in South Lorrain, and later we find him instrumental in getting the Sherritt-Gordon Mine started. In the interval between South Lorrain and Cold Lake, northern Manitoba, he had been in many places and learned many things. One of these was evidently the knack of assessing the economic possibilities of a geological report, because in June, 1932, he chartered a plane and flew into the God's Lake area, taking with him Archie MacDonald. About the middle of July, while panning some samples, they got a long tail of gold. Things then began to move with customary northern alacrity.

In the first place, men who traverse the North seem to keep an ear to the ground at all times, and the comings and goings of noteworthy characters are properly docketed and speculated upon. Thus certain men who were used to noting straws on the currents of circumstance duly marked the fact that Robert Jowsey had gone North. In ways of their own they determined where he had gone, and some of them promptly followed. As a result the news of Jowsey's discovery spread like wildfire, and a lot of staking was done in a little while.

Mr. Jowsey obtained options on a number of claims and formed God's Lake Gold Mines, which acquired his own claims and some others taken over through the exercise of options. Work was started on what was known as the Akers group, and

DRILLING CREW

R-51 "Stopehamers" in use at the Little Long Lac Mine. The vein structure is clearly shown on the back wall.

diamond drilling was carried out. In October, 1933, shaft sinking by hand was begun, and in the succeeding winter some 700 tons of freight was hauled into the mine a distance of 112 miles from Ilford on the Hudson Bay Railway. Shaft sinking by power was commenced on April 18, 1934, and by the end of the year the company had an indicated ore tonnage of 63,400, with an average grade of 0.52 ounce per ton.

At this time the company was faced with a momentous decision. The location of the property is such that machinery can be transported only during the winter season; and as lakes have to be crossed, the only certain period is that between January and March. Therefore, towards the close of 1934, the company had to make up its mind whether to take in the equipment for a mill or to let it wait for another year. It was not an easy decision to arrive at; but finally, after considering all factors, it was planned to go ahead with a mill that would go into production in the autumn of 1935. The development of hydro-electric power was also undertaken, and power rights were obtained upon the Kanuchuan Rapids on the Island River situated some 40 miles from the mine. Construction on this project was started in the fall of 1934, and electricity was delivered to the mine on August 20, 1935. During the winter of 1934-35, approximately 6,000 tons of freight was hauled from Ilford, and the property came into production as scheduled in October of 1935 with the same Eldon Brown—who had been in charge of the Sherritt-Gordon—as manager. Thus the last of the new fields began to swell Canada's output of gold.

VI

THUS we come to the end of the story that has concerned itself with eastern Canada. Its object has not been to embrace all Canadian mining history during the past 30-odd years. It has sought to follow the events which were set in motion by the discovery of Cobalt, and to give the reader an appreciation of the effects which those soul-stirring events have had upon mining in this country. We have endeavored to show the thread of sequence which has run through all of them since Cobalt amazed the world, and to prove that Canadian mining development has been in the nature of a series of steps, each one of which has led inevitably to the next.

The tracing of those steps has led us through more than 30 years. It has taken us from the horse team to the tractor, from the canoe to the aeroplane, from the untutored prospector to the specialist of today. Through those years the names of many men have echoed. Some are high in the affairs of men today; some have passed from our knowledge; and some are dead. The years are alive with memories and heavy with accomplishment, and as we look back over them we are obsessed with the knowledge that in this world of things nothing is changeless but change, and also with the certainty that change has meant progress.

It may occur to some readers that in this imperfect historic recital we have made no mention of the great Sudbury region which is the source of the world's nickel supply. That omission has been intentional. The story of the Sudbury region, of nickel, is something outside the events that have been covered. For one thing, the Sudbury region goes far beyond the 30 years we have treated here. It is more than 50 years old, and it has grown in a sense independently of the rest of northern Ontario. It is a story unto itself, and as such will be made the subject of a subsequent article. The same thing applies to British Columbia, which also, in a way, has forged its own destiny and which, accordingly, can only be dealt with separately at a later date in the manner it deserves.

Having therefore treated of these matters, there remains for us only to turn to the future, which is really not a function of history but which is, nevertheless, definitely related to the past, for it is only by the past that we can even attempt to assess the future; and it is probably in this direction that history has its most practical value.

In this series of papers we have noted a steady progression which has not been accidental beyond the first step, and it is not reasonable to suppose that that progression will cease. We know that vast areas of the Canadian Northland are still left to exercise the probing qualities of men, and so long as anything remains to be found there, men will find it, because it is in the inevitable nature of things that men are pushed by what lies behind them, and that accomplishment invariably breeds men that will carry on to even greater heights.

Through the span of this chronicle we have observed the men that Cobalt nurtured. Some of them were young when Cobalt was young, and some of them even then had passed their youth. Those men, and the men of the great gold camps, have made a mighty contribution to Canadian mining development; but 30 years is a long time, and the weight of years grows no lighter, and to other men must fall the task of shaping the future. And here again we need have no fear, because just as the first flush of mining events produced the men who have made the history of the 30 years we have traced here, so are the events of the present shaping the men who will carry on the tradition of courage and achievement that has been so ably built since the pioneers of Cobalt first planted their stakes in the then unknown North.

Fog for Movies Made to Order

MIST IN THE MOVIES

A scene from *The Littlest Rebel*, a Twentieth Century production, showing John Boles fording a river at dawn. The hazy atmosphere was created with the aid of compressed air.

"WHAT kind of fog do you want? The pea-soup variety or just a soft mist?" If you were present when a set that calls for fog is being prepared at the studios of Samuel Goldwyn Inc., Ltd., you might hear Paul B. Widlicska put that question to the director. Widlicska is the official fogmaker for Samuel Goldwyn, and he has become so expert at the business that he can produce whatever may be needed in this respect in order to make a scene realistic.

Widlicska drifted into the work by accident. He was originally a cabinetmaker, and might have remained one had not a fog that was induced artificially for a moving picture made him painfully aware of that fact. Upon looking into the matter he found that smoke and a combination of ammonia gases were being used to create a cloudy atmosphere which, while satisfactory in itself, caused eyes to smart and throats to ache. Aside from the discomfort, it interfered with production, as the players sometimes experienced difficulty in properly portraying the desired emotions.

But all that is now a thing of the past in the studios in question; and, no matter how thick the fog, there are no ill effects. Today, ordinary mineral oil is used. About 3 gallons of it is put in a steel tank, approximately 18 inches in diameter and 18 inches high, in which is a smaller steel container holding a cake of ice. When brought in contact with high-pressure air, the chilled oil gives off a vapor that is much like fog of Nature's making and can be controlled by the operator. Compressed air at 110 pounds pressure is applied, and is admitted into the tank through a jet inserted in the side. As the process is not a noiseless one, it is usually the practice to deaden the sound by enclosing the paraphernalia in a cabinet with 6-inch walls made of wood and covered with mineral wool—the fog issuing thence by way of long hose connections.

But that is not all there is to fog-making. For example, in the case of *The Dark Angel*, one of Goldwyn's current major productions, the director wanted a low-lying London fog. To create this it is necessary to heat the oil vapor, but just to the right degree so as to cause it to rise a short distance above the ground. On the other hand, to simulate an all-pervading San Francisco fog such as is shown in *Barbary Coast*, the vapor must be raised to a high temperature in order that it may reach well above the set. So adept has Widlicska become at his new calling that he can control the height and density of a fog within a few feet.

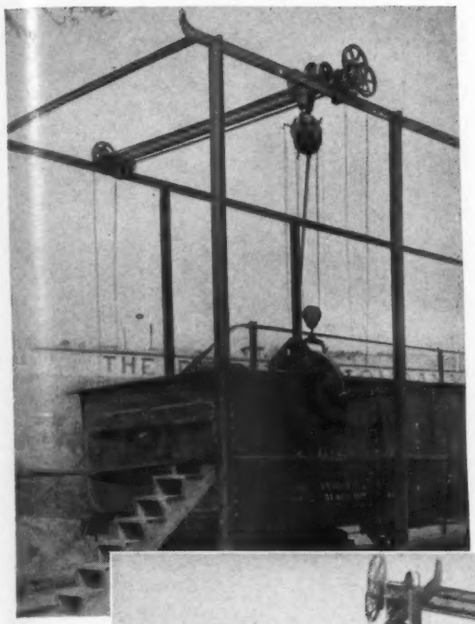
It should be added, however, that the use of oil is sometimes prohibited, and that is when the fog drifts in through open doors and windows and comes in contact with costly furniture. It is then that ordinary Chinese incense is burned. While unpleasant from the performers' standpoint, it is more satisfactory for this purpose than oil, because the latter would eventually ruin the furnishings.

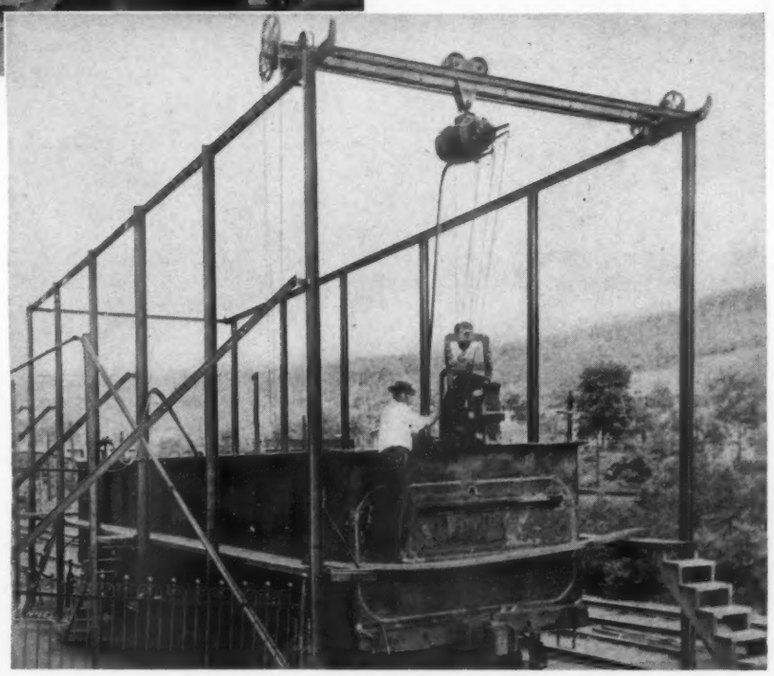
What has been done to create a nonirritant fog at the Goldwyn Studios, also applies to the Universal, the Twentieth Century, and to the other leading studios in Hollywood. While the equipment that is used to produce it may vary, the basic material in all cases is a bland mineral oil and the means of vaporizing and of distributing it is primarily compressed air.

A FOGMAKER AT WORK

Paul B. Widlicska at the controls of the equipment that enables him to create an atmosphere of fog for the taking of moving pictures. Thin, medium, or heavy fogs can be produced and, depending upon the amount of heat subsequently applied to the vapor, made to hang low over the ground or to reach any predetermined level.

Putting Freight Cars in Shape





ON THE WORK LINE

The pneumatic straightener in operation, showing the framework and the air hoist from which it is suspended. Below, the device is seen in a horizontal position with the head inside the car. At the left it is disposed vertically by the aid of a special yoke to straighten a stiffener angle that is bent downward.

AN EXCEEDINGLY useful piece of equipment in the overhauling of certain types of freight cars, and one that is said to effect considerable savings, has been developed by one of the men in the Dunmore shops of the Erie Railroad. It is a machine for straightening the stiffener angles on open-top cars and does its work with the angles in place, thus obviating their removal, re-forming in the shop, and replacing.

The straightener is compressed-air operated, and consists essentially of an Allen jam riveter provided with a special head. It is suspended from an air hoist that travels on an overhead crossbeam which, in turn, moves on rails paralleling the track or work line on which the cars are repaired. The crossbeams and rails are supported by twelve steel columns. So suspended, the straightener can be spotted over any part of a car, while its height can be adjusted to meet requirements by raising or lowering the hoist. The latter also permits lifting the device clear when a car is run on to or off that particular stretch of the line.

The machine is so placed when in service that the head—a solid block of metal—lies on the concave side of the deformation, the opening between the head and the punch being adjusted according to its character and the size of the structural member. When in proper position, compressed air is admitted into the cylinder, thus forcing the bent angle back into shape. Depending upon where the work has to be done, the straightener is held either in a horizontal or a vertical position. In the latter case a supplemental yoke is used.

This part of the overhaul of such a car is now readily performed by two men not infrequently in less than the time allotted for it in the regular repair line and at an estimated saving of $12 per car, as compared with the former method which involved taking off the angles, reshaping them in the shop, and then putting them back again.

Ore Bins and Means of Maintaining Ore Flow

THE question of properly designed ore bins at metallurgical plants is one of major importance, for the ore must be kept moving if production is to be maintained. Ore has a way of freezing, sticking, and hanging up, and means must be provided to assure a continuous feed. Man power, agitators, vibrators, steam, and compressed air are variously employed for this purpose, depending upon the character of the ore.

A comprehensive article on this subject by L. Douglass Anderson has appeared in a recent issue of the *Engineering and Mining Journal*. In commenting upon the use of compressed air for this work, Mr. Anderson says: "Compressed air can be used in several ways to bring down ore which hangs up. One of these is to make a poke rod of a piece of pipe, with a simple nozzle at one end and a hose connection to a source of compressed air at the other, with a plug cock to regulate the pressure and quantity. This device has been effectively used in freeing fine sticky ore.

"Another manner of using compressed air to cause ore to move is through the medium of pipes laid on the bottoms, and occasionally along the sides, of bins. These pipes, which may be 1¼ to 2 inches in size, have a series of small holes, about ⅛ to ¼ inch in diameter, drilled in them. The most persistent instances of hang-up of wet slimy ore have been overcome by blowing air through such pipes. The expedient does not work with loose lumpy ores, for then the air simply blows through their interstices. It was a failure, for example, when tried on sinter. But for dense compact ores it is quite effective. Frequently underground ore bins are cut out of the solid ground, usually with no way to get at them except through the small openings of the discharge gates, making them particularly difficult to bar down. Some very troublesome situations in ore bins of this kind have been overcome by the use of compressed air in the manner described.

"The fact that certain kinds of ore do not flow readily without at least some small amount of agitation has led to the introduction of mechanical, pneumatic, and magnetic means of imparting vibration to bins. An interesting new device is a magnetic vibrator built upon the principle of the vibrators used for magnetic screens and applied directly to steel bins. They can be set to vibrate continuously, intermittently, or from time to time, as may be needed. For certain conditions they are quite useful."

ANOTHER SUBAQUEOUS BORE

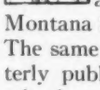
A LEGAL path has been cleared to permit the driving of a vehicular tunnel under the East River between the boroughs of Manhattan and Queens in New York City. It is expected that a contract will be let within a few weeks, and that the bore will be completed in time to serve as a means of transport to the World Fair which will be held on the Flushing Meadows in 1939.

The new tunnel will have its Manhattan portal at or near 39th Street, and, in conjunction with the Midtown Hudson Tunnel to Weehawken, will be a direct route for automobile traffic between New Jersey and Queens. The Weehawken tube is now in the final stages of construction. It is proposed ultimately to connect the Hudson and East River tunnels with a subterranean highway across Manhattan. The East River bore is expected to cost $59,000,000. To provide an instrument for its construction, the New York State Legislature has set up the New York City Tunnel Authority. This body has authority also to build a second vehicular tunnel to extend from the Battery in Manhattan to Hamilton Avenue, Brooklyn, if and when the required funds are available.

With these latest plans the insularity of Manhattan Island promises to be further negated. Already there are nine tunnels underneath the East River and five bridges across it, with another one building. All the existing bores, however, accommodate railroad traffic only, and the projected tube will be the first to carry vehicles. On its west, Manhattan is linked to the New Jersey shore by one vehicular and two railroad tunnels and the George Washington Bridge, with a second vehicular passageway soon to come into service. At the north, there are three subway rail lines beneath the Harlem River and innumerable bridges above it. Even all these connections do not suffice to meet the transport demands, and hundreds of boats ply the harbor.

A large proportion of Manhattan's food supply is still lightered across the Hudson from New Jersey, and thousands of commuters are carried over it each day. Ferries between Manhattan and Brooklyn are not so important, although much freight destined for Brooklyn still uses the water route from New Jersey railheads. Even Staten Island—the Borough of Richmond—has surrendered its insularity. Three bridges reach it from nearby New Jersey, and there have been numerous proposals to link it with Brooklyn by a tunnel or a bridge. If Peter Minuit could return to his old haunts, his surprise would dwarf that of Rip Van Winkle when he awoke from his 20-year nap.

PERPETUATING A GREETING



GLÜCKAUF, the traditional and centuries-old salutation of German metal miners, has been given a place on the official seal of the Montana School of Mines at Butte, Mont. The same word is the title of a new quarterly publication of the students of that school.

Freely translated, Glückauf means good luck. It has been the greeting of miners in Germany since the fifteenth century, or perhaps longer. During the intervening period it has acquired a superstitious significance, and at the present time no miner need obey the orders of his shift boss unless the boss first greets him with Glückauf.

Mining is an occupation that is regarded highly in the old world. Those that delve in the bowels of the earth for metal carry themselves with dignity. The miners in Germany have uniforms and bands. When they march, they carry flags and banners emblematic of their calling. Time has developed many colorful customs, traditions, and superstitions, but none is deeper rooted nor more sacred than the unvarying greeting of Glückauf. It is a symbol of the mining fraternity, and is the name of one of Germany's leading mining magazines. By its recent gesture, the Montana School of Mines has transplanted to new soil a famous and appropriate term.

STANDARD TRAFFIC SIGNS

THE time is nearing when traffic-control markings will be uniform on all streets and highways of the United States. The latest step in this direction was taken recently when standard markings were approved by the American Standards Association. This action is the result of the consolidation of the manuals on traffic regulations of the American Association of State Highway Officials and of the National Conference on Street and Highway Safety.

Leading authorities believe that such standardization will materially reduce the number of traffic accidents. The movement involves not only the standardization of traffic-control signals and markings but also a closer agreement as to where each should be used. It has been determined, for example, that in some instances signs are misplaced, and that their effect is to increase rather than to reduce accident hazards. The aim will be to insure the employment of adequate, but not excessive, traffic-control and direction markers. It is therefore planned to conduct engineering studies, and to put an end to confusion by providing a system that will meet all traffic needs throughout the country.

The new manual makes an effort to simplify road signs. It has been agreed, for instance, that the word "curve" is superfluous and that a symbol denoting a curve is sufficient. As a result of extensive tests it has been determined that the most effective color combination for signs is a yellow background with black lettering. Under a wide variety of conditions it possesses the highest visibility; and it is the intention to specify this color scheme for all signs which are considered to be of paramount importance to safe driving.

Motorists who have sometimes been bewildered by the profusion and variation of road and street markings will welcome this uniformity. Adoption of these standards will not only make all thoroughfares safer for riders and walkers but will also eventually save the taxpayer money.

This and That

Birth of Plastics

Few men discover things of such importance that the world knows them by name. One of the chosen few was Dr. Leo Hendrik Baekeland, who found out how to combine carbolic acid and formaldehyde and thereby gave us the substance called bakelite. Today this material forms essential parts of our radio sets, our automobiles, our telephones, and of countless other articles of everyday use. Doctor Baekeland, who had already invented Velox photographic paper, came upon the method of making this resinoid compound 25 years ago. The corporation which he founded now manufactures 2,000 varieties of bakelite materials and has factories in five foreign countries.

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What Makes a Dam

Up to December 20, the Mason-Walsh-Atkinson-Kier Company had issued 12,000 individual orders to cover purchases in connection with the rearing of Grand Coulee Dam. Invoices aggregating more than $10,000,000 had been approved. The materials bought ranged in size from pins to 140-ton power shovels. To single out one relatively small part of the complete job, the following are some of the items that entered into the construction of the west cofferdam: 1,000,000 board feet of lumber, 121 miles of steel sheet piling weighing 12,600 tons, 30 steam hammers, 4,500 tanks each of oxygen and of acetylene, and 1½ miles of steam hose. About 30 purchase orders a day are normally issued. The largest sum of money expended on a single purchase so far was $50,000, and the smallest was fifteen cents. Some idea of the amount of figuring involved on such a construction project may be gained from the fact that as many as 10,000 pencils of various kinds have been bought to date.

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Roadmen to Aid Scientists

Highway workers and contractors in Montana have been enlisted in the cause of archaeology. Written orders have been issued to them by D. A. McKinnon, state highway engineer, to maintain a close watch for indications of prehistoric life while excavating. In the event that they find fossilized bones, weapons, tools, ashes, or other signs of fire, they are instructed to stop work immediately and to refrain from disturbing the objects until they can be looked at by someone competent to identify and to appraise them. It will be remembered that the now famous prehistoric Minnesota Man was discovered in a highway cut because of similar instructions that had been given in that state. Other finds of importance have been made in Wisconsin, Nebraska, Nevada, and New Mexico. As it is fairly well established that a race of men that used stone implements roamed this continent at the time the ice cap still extended far to the south of its present terminus, there is good reason to believe that evidences of this occupation still exist and lie buried in the postglacial gravels and soils. The Montana School of Mines is coöperating in the search, and will send someone to inspect any promising discoveries that may be made on road-building projects.

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Novel Leak Closure

In an effort to stop a flood of water that had been pouring into the workings of a $3,000,000 colliery in Illinois for seven weeks, workmen last month introduced hundreds of bushels of corn, soy beans, and sawdust by forcing them through a hole drilled from the surface so as to intersect the subterranean flow. This expedient was tried as a last resort to save the property and to restore the means of livelihood of most of the 6,000 residents of Johnston City. The principle back of the experiment is based on the well-known fact that the materials used absorb vast quantities of water and swell to as much as twice their normal size. The report is reminiscent of the scheme proposed some years ago by Simon Lake, submarine authority, to seal and to float sunken ships by displacing the contained water with a similar material pumped down into them from surface craft designed for the purpose.

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When Cave-ins Occur

More mine cave-ins are said to occur during periods of new or full moon than at other times. An astronomer in Denver recently accounted for this fact as follows: The pull of the moon creates land tides just as it does ocean tides, and a wave 4 or 5 inches high travels around the earth. This tends to dislodge loose material from the roofs of relatively shallow tunnels and other subsurface openings. In its daily rotation, the earth exhibits a forward and a rear hemisphere. At midnight we reach the center of the shadow cast by the sun, and from then until the following noon we ride on the forward half of the globe. During that period the roofs of all horizontal tunnels are slightly ahead of their floors, and this motion tends very slightly to push loose material away from the roof and toward the floor. At six o'clock in the morning—the half-way point—this tendency is strongest, because the push is then directly against the earth's forward motion. During new moon and full moon, the sun, earth, and moon are in line, and the influences just set forth combine. Thus, six o'clock in the morning of full moon or of new moon is considered to be the time when it is most dangerous to be underground.

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Don't Pass on Curves

On a highway where a speed of 50 miles per hour is permitted you will travel 900 feet in overtaking and passing a car which is going 40 miles per hour. To insure safety in performing the maneuver, you should therefore not attempt to pass unless you have a clear view of at least 900 feet of the road ahead. This is the conclusion reached by the National Bureau of Standards as a result of a series of experiments and observations. If the vehicle in front of you is traveling only 20 miles an hour, you can safely pass it in a stretch 650 feet long. Assuming that two cars are moving at the same rate, and that the rear one speeds up to pass, several hundred measurements have shown that about six seconds will be required to get around it and back on the right side of the road. This time element is the same regardless of the speed of the two cars prior to the act of passing. The tests were conducted for the purpose of helping highway engineers to construct roads that will contribute considerably to safer driving.

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Our Mineral Wealth

The great importance of our mineral industry as a contributor to national income is brought home forcefully by a table that accompanies a brochure entitled *The Future of Metal Mining in the United States*. The booklet was recently published by George W. Danehy, a Denver mining engineer. The dividends paid by American copper companies are computed to be $2,522,010,000. Assuming that production was ten times the dividends, Mr. Danehy places the contribution of the "coppers" at $25,000,000,000. In similar fashion he lists the dividends from gold mines at $251,773,450, and those from silver mines at $147,164,900. He does not attempt to estimate the total output of each, but points out that these three classes of mines have poured forth ores having a value easily sufficient to retire our national debt. The largest dividend payer has been Kennecott Copper, with $245,000,000 to its credit. Among the gold mines, Homestake is the leader with $83,664,000. In compiling these figures, the mines that have been unproductive since the year 1918 were not taken into account.

Industrial Notes

If you want to know all about nails—the kinds available, their common defects, etc., write for the combined textbook and catalogue on nails published by The Angell Nail & Chaplet Company, 4580 East 71st Street, Cleveland, Ohio. It has 44 pages, and is profusely illustrated.

By means of a newly devised instrument it is said to be possible to determine the aging rates of materials which, in most cases, is due to an oxidizing process. It is claimed that with the Oxydator, as it is called, the data for a complete aging curve can be obtained in one hour and forty minutes.

An innovation in house heating has been introduced in England where a manufacturer is producing a "wall paper" that carries the heating element. This is in the form of a very fine copper-nickel resistance wire that connects with the electric system and is controlled thermostatically. It can be raised to any desired temperature up to 85°F.

One of the new forms of protective wrappings consists of a liquid rubber that can be applied either by dipping, brushing, or spraying. It is called Kelsanite and, when dry, is said to be air and waterproof, as well as highly resistant to acids, etc. The material has a wide field of usefulness in industry in protecting, for example, surfaces of metal, wood, composition, etc., in process of manufacture or in storage, as well as tools and equipment temporarily not in service. Kelsanite can be peeled off with ease.

Standardization has reached the drafting room and promises to do away with the lack of uniformity that has heretofore characterized drawings originating in different establishments. There is now available a guide or graphical "dictionary" that will enable draftsmen to make drawings that will be intelligible to anyone capable of reading them. The work was sponsored by the Society for Promotion of Engineering Education and the American Society of Mechanical Engineers, and has been adopted by the American Standards Association.

An Omission

THROUGH an oversight, no mention was made of the builder of the Hayden Planetarium in the article on *A Theater of the Stars*, by Allen S. Park, which appeared in the January issue of this MAGAZINE. That structure, which is characterized by a dome of unusual design and proportions, was erected by the well-known White Construction Company, Inc., 95 Madison Avenue, New York, N. Y.

Cellophane to be fit for sale must be smooth. To assure a satisfactory product, its handling has necessitated the development of special machinery, and in one of the newest of these compressed air irons out the creases or wrinkles, or, to be more exact, prevents them from forming at one stage in the operations. In order to cut cellophane into marketable lengths, the tension under which it travels between feed rolls must be periodically released, causing a certain amount of slack in the ribbon or sheet. This slack must be taken up if the surface of the material is not to be marred during cutting. In the machine in question this is done by a properly timed blast of compressed air, which forces the strip down sufficiently in advance of the cutting area so that the cellophane within the latter is always under tension. The device is the invention of Adolph Potdevin.

As a safeguard to navigators, the four San Francisco-Oakland Bay Bridge piers that stand in the channels created in Oakland Bay by Yerba Buena Island have been provided with bells. There are five all told, two on the great central anchorage and one each on Piers E4, E5, and E6 in the East Bay crossing. The former are about 40 inches high and weigh 3,000 pounds each, while the latter have a height of approximately 30 inches and weigh 1,600 pounds. These bells ring out their warning to shipping in times of fog and during dark and stormy nights. The largest vessels afloat, such as the *Normandie*, can pass under the bridge with sufficient clearance.

Ersatz has been and still is a familiar word in Germany, which might with propriety be called the land of substitutes. According to a report by the Chemical Division of the U. S. Department of Commerce, the world's first methane-gas station for automobiles was established several months ago in the Ruhr district. The methane dispensed there is recovered from coke-oven gas, and is stored under high pressure in tanks which serve as filling stations for motor vehicles. More than 200 trucks in the Ruhr basin are already using this new fuel, and the number is said to be steadily increasing.

Whether or not Germany has taken the lead in this matter, the Spokane United Railways, on our Pacific Coast, have for several months been maintaining butane service stations for their buses. Each of the two storage tanks originally built by them has a capacity of 12,500 gallons, while the third, which was recently completed, holds twice as much. A fourth 25,000-gallon tank station is contemplated. All the company's buses, totaling 64, are being converted to run on butane gas, which is one of the methane series. Twelve new buses are being added to the fleet that will make use of these unique service stations, which consist essentially of a fuel tank, a loading stand, and dispensing equipment.

Spray cabinets have found their way into the bakery where they are said to be doing highly satisfactory work in coating biscuits, crackers, cookies, cakes, etc., with butter, flavoring extracts, coloring matter, and other fluids that can be applied with air guns. The foodstuffs are carried through the booth on a conveyor screen between two sets of nozzles so that the tops and bottoms can, if desired, be sprayed simultaneously. A tray beneath the conveyor catches the crumbs, while drippings are reclaimed for reuse. One large bakery has reported a saving of as much as 1,000 pounds of butter a day by the use of such a machine. The unit is mounted on casters so that it can be shifted from oven to oven.

Waterproofing Concrete With Copper

AFTER three years of application in Germany, there has been introduced in the United States a method of waterproofing concrete that makes use of very thin sheets of copper in combination with special bitumastic compounds. The insulation is known as Heku, and is applied as follows:

The concrete base, whether it happens to be the deck of a bridge, the walls of a tunnel, or the foundation or roof of a building, is covered with two coats of bituminous materials. The first of these is put on cold and the second one hot. The latter is of a sticky consistency and serves as a binder for the metal that is placed on top of it with the edges overlapping several inches. The copper comes in rolls, and is 0.004 or 0.008 inch thick. After the metal has been laid—that is, pasted down—and the joints have been made tight with hot bitumen, the entire surface is given a final coat of hot liquid asphalt by the aid of spray guns.

The seal thus effected is said to be effective, lasting, and economical. In the case of the new bridge over the River Elbe at Meissen, Germany, the concrete deck was made waterproof with Heku at a cost of approximately $2.40 per square meter (10.76 square feet), including labor. A total of 15,400 pounds of copper sheeting 0.008 inch thick was required to cover an area of 3,500 square meters (37,670 square feet). In 1934, something like 200 structures, representing 700,000 square feet of surface, were thus made watertight in Germany.